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NEW PLANS FOR THE MISSISSIPPI

General Review of Present Program

First of a Series of Eight Articles

As part of the undertaking of stabilizing the stream, several cutoffs of bends are being made—Elaborate investigations are in progress to clarify the problems of hydraulics of flow, movement of detritus, protection of banks and regulation of the navigable channel by contraction

ON JAN. 8, 1933, a powder blast blew away a bank of earth between two dredge cuts across the neck of Diamond Point, 40 river miles south of Vicksburg, Miss., and completed the first planned cutoff of a Mississippi River bend that had been made in nearly a century. The event marked the first practical application of new views toward the river channel control problem and a new engineering attitude toward it that had been evolving within the Mississippi River Commission for some time and that took definite form last summer under the leadership of Gen. H. B. Ferguson, president of the commission and division engineer of the Lower Mississippi Valley Division of the Corps of Engineers, who is in charge of the flood-control work from Cairo to the Gulf of Mexico.

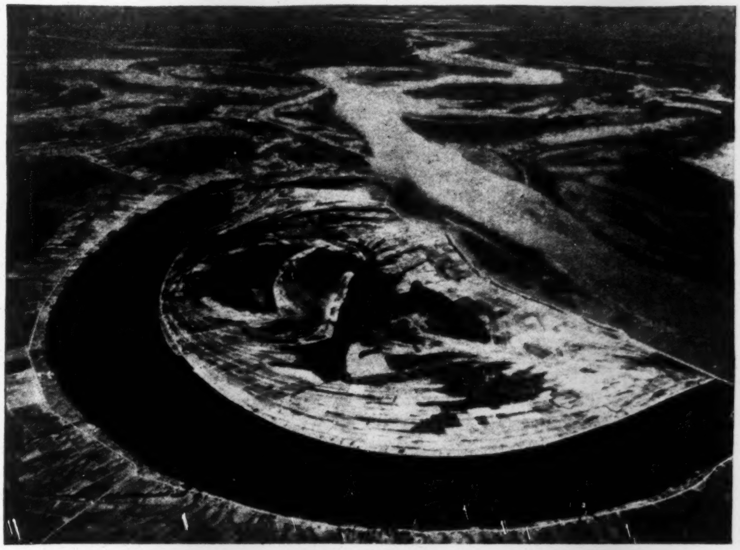

Fig. 1—Characteristic windings of the Mississippi River to which the most difficult features of the stabilization problem are due. This view faces north from Lake St. John, 682 miles below Cairo and about 25 miles above Natchez in the vicinity of Waterproof Cutoff, formed in 1884.

For a century the prevention of cutoffs had been a traditional first principle of river control on the Mississippi. Since 1879, when the Mississippi River Commission was established, that body had adhered consistently to this principle. Cutoffs were regarded as disastrous happenings, to be fought off as long as possible. Now this principle is discarded, in partial accord with opinions held by a small minority of river engineers for a number of years past—namely; that straightening and shortening the river's course to improve flow conditions and flood-carrying capacity is an essential of an efficient program of flood control. Three cutoffs have now been opened, and more may be made.

These facts, with others equally important though less obvious to the onlooker, inaugurate a new period in the history of Mississippi River engineering. Back of them lies a far-reaching series of engineering studies and model experiments. While these are still in progress and indeed are hardly more than begun, they already give assurance of building up a body of new knowledge on vital factors of the river's action. There is prospect that by thus removing some of the mystery that has hitherto enveloped the subject they will lay the foundation of scientific understanding of the hydraulics of the Mississippi.

Because of the great engineering importance of these developments, as well as their practical public interest, the chief facts about the new work under way will be set forth in a series of articles. The present article gives a general account of the main problems at issue, the methods of attack and the views tentatively formulated. Subsequent articles will describe the cutoff operations, contraction works, new revetment types, the novel agitation dredging of the lower course of the Atchafalaya River (the auxiliary outlet of floodwaters of the Mississippi) and the remarkable model studies of the Vicksburg hydraulic laboratory which have contributed facts and purpose to the new thinking.

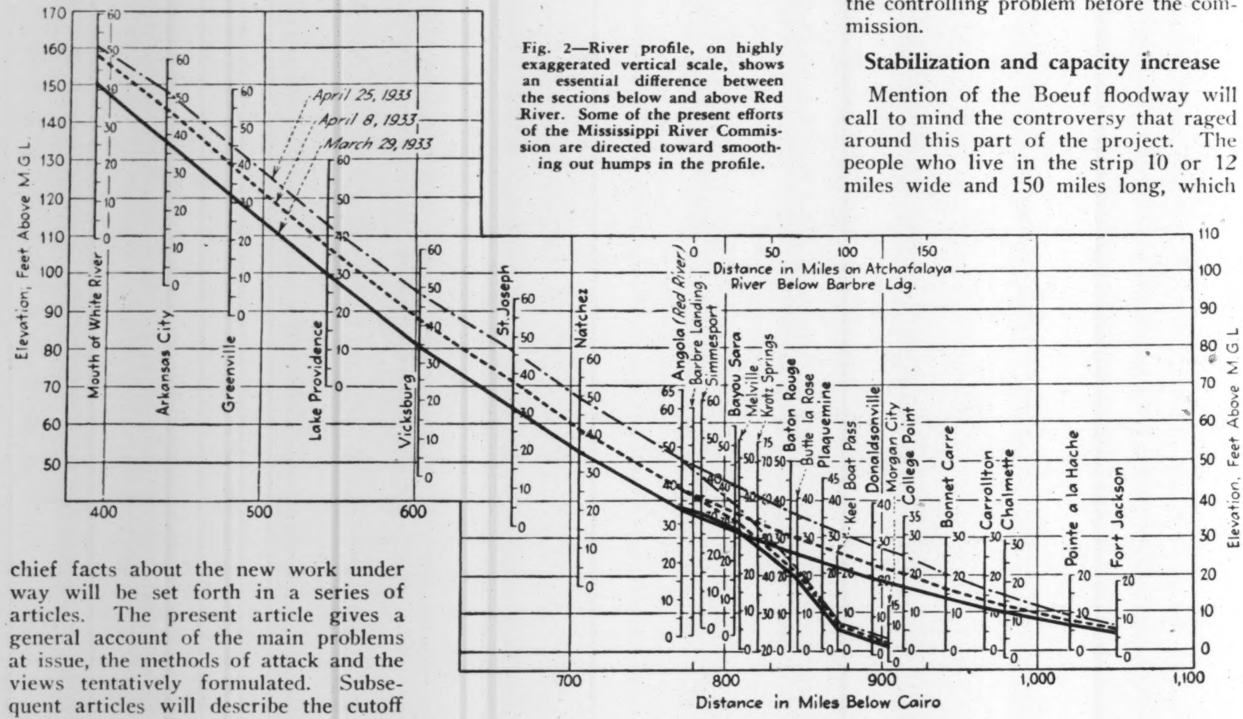

Fig. 2—River profile, on highly exaggerated vertical scale, shows an essential difference between the sections below and above Red River. Some of the present efforts of the Mississippi River Commission are directed toward smoothing out humps in the profile.

Present state of the project

For proper orientation it is desirable to recall that the 1928 flood-control project, drawn up after the record-breaking flood of 1927, contemplated (1) the raising of the levee line by about 3 ft. above the previously adopted or 1914 grade line, along the whole length of about 1,000 miles of river from Cairo to near New Orleans, to carry a flood ranging from 2,250,000 sec.-ft. at Cairo to 3,000,000 sec.-ft. in the lower river; (2) the construction of an emergency spillway at Bonnet Carré, just above New Orleans, capable of discharging 250,000 sec.-ft. of floodflow into the upper end of Lake Pontchartrain (an arm of the Gulf of Mexico); (3) the construction of three wide floodways outside the normal leveed width of the river's high-water channel, one just below Cairo (Birds Point-New Madrid floodway) to lower the flood crests at Cairo, a second from the mouth of the Arkansas southerly through the westerly half of the Tensas Basin (Boeuf floodway) to carry the excess floodflow which the leveed river apparently could not accommodate, and a third along the course of the Atchafalaya River, to carry 1,500,000 sec.-ft. of water from the Red River and from the Boeuf floodway discharge directly to the Gulf, leaving only the remaining 1,500,000 sec-ft. to go down past Baton Rouge and New Orleans. In addition to these specific construction operations, to which some $200,000,000 was allocated, stabilization of the river channel was to be carried out, and something more than $100,000,000 was provided for this purpose. Methods of stabilization beyond the customary bank revetment were not set out but were left to be developed by the commission through subsequent studies and experience.

Of the total project the critical levee work on the main river is nearly completed. About 385 miles of levee remain to be raised, and of this 148 miles is opposite backwater areas. Of the remaining 237 miles more than half is north of Helena (in the Memphis District). The Missouri and Bonnet Carré floodways are completed. The Atchafalaya guide levees have been started. Nothing has been done in the Boeuf except partial construction of the West Monroe circle levee and initial work toward building a levee ring around the city of Monroe, half of which is to be constructed during 1933. A beginning has been made on stabilization of the reach above Helena by building an extensive system of spur-dike contraction works and some bank revetment. The levees of the Memphis District will be completed this year if adequate appropriations are made. Thus, the first two-thirds of the flood-control project is well along toward completion (except for the Boeuf floodway), and the remaining third, river stabilization, is now the controlling problem before the commission.

Stabilization and capacity increase

Mention of the Boeuf floodway will call to mind the controversy that raged around this part of the project. The people who live in the strip 10 or 12 miles wide and 150 miles long, which was to be inclosed within the floodway guide levees, feared that the value of their property would be destroyed without recourse, as the law made no provision for compensation to be paid them. They applied for an injunction to restrain the building of the floodway levees, but finally lost in the U. S. Supreme Court on legal grounds, the decision making no finding as to whether they would suffer damage from construction of the floodway. Because of this controversy no work has been done on the floodway, and instead the commission and the chief of engineers, Gen. Lytle Brown, have sought to find means of confining the full floodflow within the river levees from the mouth of the Arkansas to the Red, so that the Boeuf floodway might be discarded.

In other words, increase of river-channel capacity has been sought. To this end, studies of river stabilization

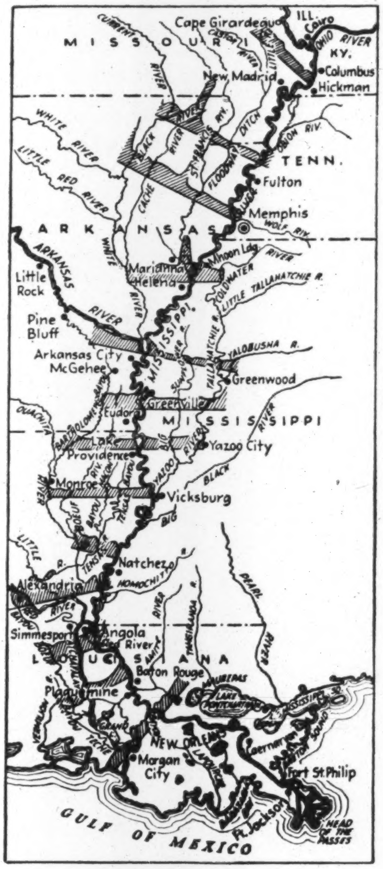
MISSOURI
ILL.
Cairo
Cape Girardeau
OHIO RIVER
KY.
Columbus
Hickman
New Madrid
CURRENT RIVER
CASTOR RIVER
LITTLE RIVER
WHITE RIVER
LITTLE RED RIVER
BLACK RIVER
CACHE RIVER
ST. FRANCIS RIV.
FLOODWAY
DITCH
OBION RIV.
TENN.
Fulton
Memphis
WOLF RIV.
ARKANSAS
Little Rock
Pine Bluff
ARKANSAS RIVER
WHITE RIVER
Marianna
Helena
Mhoon Ldg.
COLDWATER RIVER
LITTLE TALLAHATCHIE R.
MISSISSIPPI
YALOBUSHA R.
TALLAHATCHIE R.
SUNFLOWER R.
Arkansas City
McGehee
Greenwood
Greenville
Eudora
MISSISSIPPI
OUACHITA
BARTHOLOMEW BAYOU
Lake Providence
Yazoo City
BIG BLACK
YAZOO RIVER
Monroe
Vicksburg
BAYOU BOEUF
TENSAS
LITTLE R.
Natchez
HOMOCHITTO R.
Alexandria
RED RIVER
PEARL RIVER
Simmesport
Angola
Red River
AMITE
TANGIPAHOA
LOUISIANA
Baton Rouge
MAUREPAS
LAKE PONTCHARTRAIN
MISSISSIPPI SD.
Plaquemine
VERMILION
TECHE
GRAND
NEW ORLEANS
LAFOURCHE
Caernarvon
BRETON SOUND
Morgan City
Fort St. Philip
Ft. Jackson
HEAD OF THE PASSES
GULF OF MEXICO

Fig. 3—Flood basins, tributaries and trans-valley profiles on the Mississippi River below Cairo.

have been coupled with broader study of the river hydraulics, to explore the possibilities of increasing the flow capacity. However, as stabilization itself involves the full range of hydraulic facts and actions in the river, the two objectives are in effect different aspects of the same general question—namely, to determine the laws of flow of the river and the operation of all factors that influence the flow.

The river inefficient and unstable

A glance at the view, Fig. 1, and the maps of typical stretches of the river, Figs. 4 and 5, makes it plain that the river is characterized by a tortuous course. The irregularity of its longitudinal profile is also to be noted. These conditions mean that the river is not an efficient hydraulic conduit—it is far different from a uniform, straight trough for carrying the discharge of the tributaries to the Gulf. Further, they mean that the river is constantly tending to shift its course, since it attacks and erodes its banks at the sharp concave curves and deposits the detritus in the straight reaches and at the heads of points and islands. Left to itself, it is inherently unstable.

Maps of the river cover a period of more than a century. Careful comparison of these maps reveals a history of channel shifts as typically shown by Fig. 4. The river evidently has been carving its course into new forms constantly, and in effect has wandered freely over the strip of land between the levees. Often the levees themselves are attacked in this shifting and must be relocated farther back. Thus the safe maintenance of the river works is costly, hazardous and requires constant care; lasting security is contingent on curbing the river's tendency to wander.

As seen from an airplane, the ground surface on the banks, often for miles back from the river (Fig. 1) is marked by an infinity of curved furrows and lines of vegetation. These are the locations of old bank lines, and show that the river has worked over every foot of ground within a wide area, in quite the manner indicated by Fig. 4 for a narrower area. And all along the river's course, sometimes a few hundred or a few thousand feet away but frequently 40 or 50 miles back in the basins, are found hundreds of oxbow lakes, remains of former sections of riverbed. Evidently the river is only temporarily in its present place; its natural tendency has been to wander freely over the whole width of the alluvial valley, including the extensive basin areas—the St. Francis, the Yazoo, the Tensas-Boeuf and the Atchafalaya.

Under the present settled and cultivated condition of the valley the river must be confined to the narrow leveed strip, as in Fig. 4. But even in this area uncontrolled shifting is costly in the constant loss of fertile land and the frequent destruction of main protective levees. Economy in control of the river therefore must look to a substantial fixing of the location of the channel. While this might be relatively easy with constant flow, the actual flow ranges from about 100,000 sec.-ft. at low stages to more than 2,000,000 sec.-ft. in high floods, and the flood rise is 45 to 60 ft. at different points. Further, the path of low-water flow and the lower part of floodflow is along the winding channel, while the upper part of the floodwater passes in a straighter shorter course along the line of the leveed width. This means turbulent flow and many cross-currents, complex erosive forces at different stages and irregular movement of detritus. The hydraulics of either flow or stabilization are thus of utmost intricacy.

Rectification and slope regulation

Improvement and rectification of the leveed high-water channel have progressed more or less continuously since the early levee lines were established directly along the banks of the winding channel. When the lines could not be held at projecting points, new levees were built back of the points. Such widening and straightening has been particularly active under the 1928 project, and much of it has been done with the direct object of removing constrictions and sharp turns from the high-water channel. The plan, Fig. 6, a section of the river between Greenville and Vicksburg, brings out specific instances of such improvement. Its effect is to smooth out and lower the flood slope thus increasing flood capacity.

Rectification of the levees is only partly effective, since a large part of the floodflow follows the course of the winding channel. Maximum flow capacity could be obtained only by similarly straightening the channel itself. This idea of converting the river into an efficient discharge conduit has been entertained by a number of engineers, in recent as well as earlier years. The majority opinion was decisively opposed to this view, however.

At an early date the doctrine took root that the river requires to have such a channel length as to attain a certain slope, presumably the ideal slope, and that if its length were changed it would always spontaneously readjust its course to regain its previous length. The doctrine found support in the fact that the measured length of the river at dif-

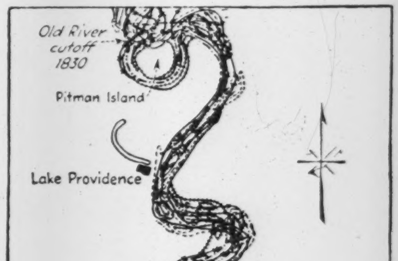
Old River cutoff 1830
Pitman Island
Lake Providence
Terrapin Neck cutoff, 1866
Yazoo cutoff 1799-1800
YAZOO RIV.
LEGEND
Channel in 1930
1913-21, Miss. Riv. Comm. Surveys
1881-93, " " "
1861, Delta Survey (Humphreys & Abbot)
1820-34, Youngs Survey and General Land Office Surveys
1765, Ross Map
Centennial cutoff, 1876
Vicksburg
0 2 4 6
Scale in Miles
Davis Island
Davis Island or Palmyra cutoff, 1867
BIG BLACK RIV.
LAKE ST. JOHN
Yucatan cutoff, 1930

Fig. 4—Constant change of the channel, as recorded by surveys extending over a century, reflects the present-day difficulty of fixing the river course.

ferent periods of time, years apart, when its course was quite different, appeared to total closely the same number of miles; and the further fact that whenever a cutoff occurred, shortening the channel by say 20 miles, new meandering would soon develop on either side of the cutoff, again increasing the length by about the same 20-mile amount. These facts are the sole foundation for the doctrine mentioned. No other reasons to support it appear to exist; but it has been an article of faith along the river.

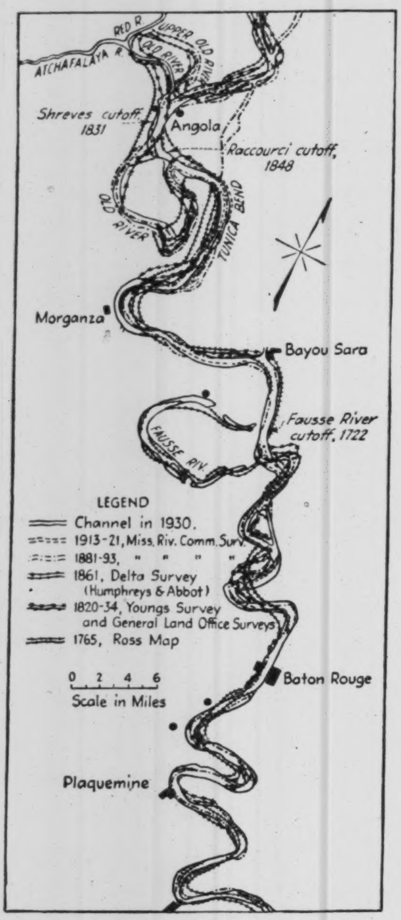

Fig. 5—Records of 165 years of channel changes below Baton Rouge reflect a high degree of stability. Compare with Fig. 4, which is typical above Red River.

On related grounds it came to be fundamental doctrine that necks must be held against cutoff at all costs. The constantly shifting bends of the river do not normally retain an easy curvature but tend to become sharper, the loops of the channel recurving toward each other more and more by cutting into the base of each point until the point is a broad peninsula with a narrow neck. Floods passing across such a neck may cut a permanent channel through it.

In 1831 and 1848 intentional cutoffs of bends were made near the mouth of the Red River to improve navigation. These are still known as Shreves cutoff and Raccourci cutoff. The new channels created by these cutoffs gradually changed, but by 1882 had regained only 5 miles of the original 34 miles of shortening. Between 1882 and 1929 an additional 4.4 miles were regained. Between the time of the Shreves and Raccourci cutoffs and the organization of the Mississippi River Commission about ten other cutoffs occurred, as will be described in a subsequent article. Some of these later cutoffs, notably the ones at Centennial and Commerce above the mouth of the Arkansas, were followed by rather pronounced changes in river regimen.

When the Mississippi River Commission was organized the membership considered the effects of various cutoffs and adopted the policy that cutoffs must be neither made nor permitted. This policy was strictly adhered to, and, with the exception of the Waterproof Cutoff in 1884, no major cutoff was permitted until the Yucatan Cutoff occurred in 1929. This half-century fight of the commission to prevent cutoffs was carried on by protecting necks and bends with levees and mattress revetment. High dikes were built along the narrow necks to check flood erosion, notably at the Greenville Bends, the most remarkable group on the river.

Model-experiment attack on river problems

In 1929 the commission decided to apply laboratory experimentation to its river problems, primarily that of stabilization. It built the Waterways Experiment Station near Vicksburg (*ENR*, July 16, 1931, p. 84) and began intensive flume and river-model experimentation late in 1930. In this work the doctrines just mentioned were not respected. Cutoffs were tried out, with encouraging results. Both concrete channel beds and sand beds were tried, respectively, in the study of hydraulic factors and detritus movement.

When scientific methods were thus applied to the river problems, it became apparent that many data essential to technical study of the river were lacking, and that certain actions probably influential in the river's behavior had been ignored. Little was known of the factors controlling river slope and depth. The nature of the bottom and its relation to erosion had been only imperfectly explored. Factors of water velocity, turbulence and transporting power of the river were obscure. Much attention had been given to the fine material carried in suspension, but little to the heavier material carried along near the bottom. What became of this detritus and how it contributed to bar formation, to the meandering tendency, and to closure or maintenance of chutes around islands was quite unknown.

Moreover, some direct errors had become fixed in accepted literature. For example, it was taken to be an established fact that, when a cutoff shortened the river and temporarily introduced a section of abnormal slope, the abnormality equalized itself both by upstream lowering and by downstream raising of the water plane. But model experiments soon showed that the supposed downstream effect did not occur, and that the range of the upstream effect was rather limited. It was therefore concluded that the new investigations would have to go back to first principles everywhere, without reliance on prior beliefs or supposed facts.

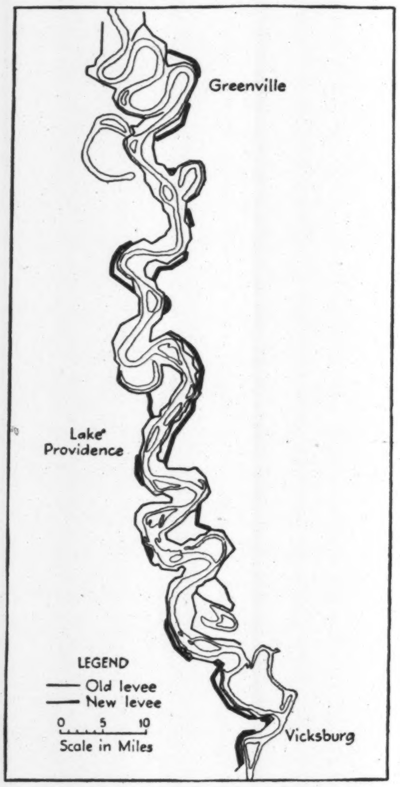

Fig. 6—Much rectification of the high-water channel has been accomplished by setting back the levee line at projecting points, as shown in this stretch between Greenville and Vicksburg.

As has already been remarked, the studies of river hydraulics and of stabilization are merely separate aspects of the same investigations, both of them involving the full range of river data and actions. In consequence, the following notes, though grouped under separate subject heads, are to be taken as closely interrelated.

Floodway questions

Serious doubts have been current in some quarters as to the action of the floodways. The New Madrid floodway, it has been charged, would not reduce the Cairo flood height below the danger point, and in any event its operation would develop destructive erosion at many points within the floodway, making the floodway land practically valueless and justifying compensation for its full value. Model experiments demonstrated that slightly more than the expected lowering of flood height would be produced, and gave full data for predetermining amount and distribution of velocities in the floodway.

Similar capacity and flow-velocity experiments on the Boeuf floodway verified the floodway discharge capacity assumed in the design of the project. and showed that the velocitities everywhere except just below the entrance will be so low that no erosion of soil is to be apprehended. Utilization of the Boeuf valley for floodflow therefore involves only risk of submergence and not destructive current effects. Even so, the land cost may prove to be prohibitive.

Capacity increase

In connection with these investigations, attention was drawn to the slope irregularities in the riverbed and water plane, and to the large effect of the hydraulic properties of the low-water and high-water channels on leveed capacity. As a result, field studies of river profiles and model studies of channel rectification were begun. The profile and slope studies led to general investigation of character of bottom soil and the amount, nature and movement of detritus along the bottom. These latter subjects in turn had a bearing on bank erosion, bar formation, location and effect of revetment and contraction works, and maintenance of chutes and channels.

Slope irregularities, chiefly concentrated at a few locations, appeared to have an important influence on river capacity and height of flood plane. Among these locations are the lower or delta section of the Atchafalaya River (between Butte la Rose and Grand Lake), a section of the Mississippi just below Natchez, a section above Vicksburg, and the Cairo-New Madrid section. Whether the irregularities represent in part surviving effects of bed slope adjustment after cutoff below or whether they are reefs due to hard bottom could not be judged. An extensive program of bottom sampling has been initiated to throw light on the question; more is likely to be known about it when the soil analyses have been completed. But the present view of General Ferguson and the commission is that if the slope irregularities can be smoothed out, the river capacity can be increased materially and flood heights can be lowered.

It is known or believed also that inefficient hydraulic conditions at divided channels, as at islands or old cutoffs, interfere with developing maximum channel capacity. The river generally in its course maintains a single channel; a second channel—as, for example, the original channel at a bend bypassed by a cutoff—soon closes up, leaving a lake or a mere slough, with no connection to the river, or only vestigial connection. The full flow going through one channel maintains effective scouring action and normal depth, width or slope. But this is not universally so. At many points there are permanent islands that divide the flow, and the minor channel does not close up; certain cutoffs also retain an open and often navigable backchannel, and the best depth and largest volume of flow may be found in one channel during one year and in the other channel the following year. Where the flow is thus permanently divided the river slope is usually steeper than normal and the capacity is reduced.

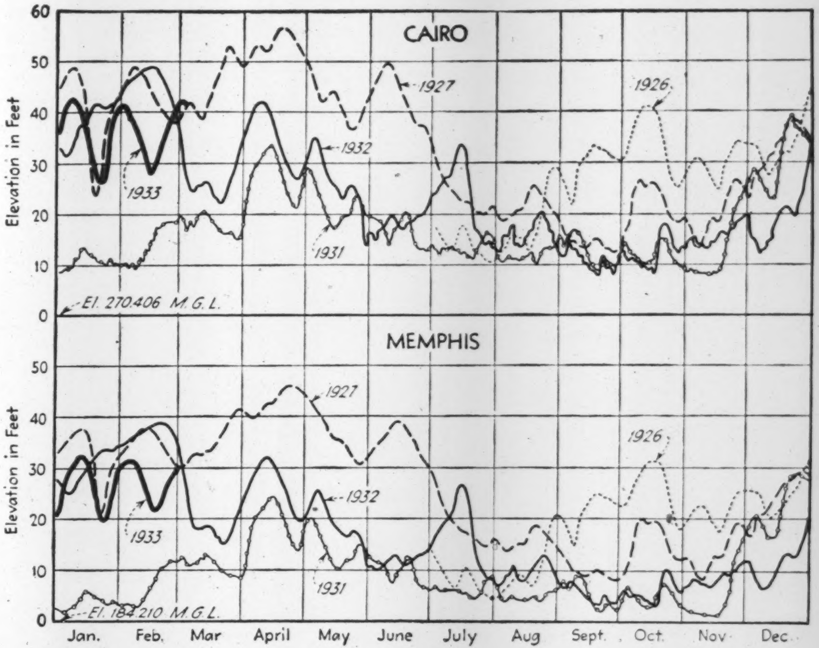

Fig. 7—Typical hydrographs for a year as registered on the gages at Cairo and at Memphis.

Study is therefore being directed toward the conditions that lead to divided flow and toward means for inducing spontaneous closure of back channels in order to improve the hydraulic properties of the main channel. Present results suggest, at least at certain points, that the shape of the upstream end of the island in relation to the river alignment just above has a controlling influence on detritus movement and directs it away from the back channel, thus tending to maintain the latter. The indications are that control of divided-channel conditions may prove possible, and that it may permit of reducing slope irregularities, improving channel depths and increasing the floodflow capacity.

An aggravated case of divided-channel flow coupled with abnormally steep slope in a short bottleneck section was found in the lower delta portion of the Atchafalaya. Here the deposition of sediment produced a permanent constriction that raises the water plane in the middle and upper sections of the river, causes extensive ponding of floodwaters in adjoining low areas and reduces the discharge capacity of the stream. To enable the Atchafalaya to carry half the extreme floodflow of the lower course of the river, the commission concluded that this constriction must be removed and the slope of the Atchafalaya equalized, and that by proper alignment of a dredged main channel an approximation to self-maintaining single-channel flow should be created. This novel operation, carried out by original dredging methods, was begun last winter and will be described in a later article.

Channel straightening by cutoffs

In view of the obvious hydraulic inefficiency of a tortuous channel, such as is shown in Fig. 4, and the importance of developing maximum floodflow capacity for safety, as well as to assist in solution of the Boeuf basin problem, large-scale model experiments on cutoffs were begun soon after the Waterways Experiment Station was established. Many cutoffs were tried singly and in groups, first with fixed bed (concrete-lined channel) to determine the resulting slope readjustment and then with movable bed (sand filling) to study erosion and bar-formation tendencies. The outcome was favorable with respect to certain cutoffs, and the commission decided that several cutoffs between Vicksburg and Natchez should be undertaken. Experiments on several cutoffs between Helena and Vicksburg were also favorable.

These experiments and decisions were in sharp conflict with river tradition, as has already been brought out. The fact is that the progress of work on the 1928 project and studies in connection with it forced the engineers increasingly in the direction of giving principal consideration to the hydraulic-flow characteristics of the river. As the river itself does not everywhere show meandering tendency but has a number of straight reaches up to 20 or 30 miles long, some of which have been stable through a long period of years, it appeared that a reasonably straight alignment can be maintained. Further, the probable cost of holding the river after a cutoff has been made is not necessarily greater than the cost of maintaining defense of a troublesome set of bends.

Changes in the river indicated, moreover, that some cutoffs were likely to occur spontaneously; also, at one or two island bends, the shifting of bars and alternation of channels was so troublesome and costly that even the radical experiment of a deliberate cutoff might be warranted. Forty miles below Vicksburg, where the small channel of the Big Black River comes in from the east and for some miles runs parallel and close to the Mississippi, a breakthrough that would divert the main river into its channel and so cut off Yucatan Bend has been in prospect for at least fifteen years. During all this time the commission (or at least some of its members, including the late J. A. Ockerson) was willing to let the cutoff occur. It finally did occur, through the operation of natural forces in 1929, though enlargement of the Big Black channel proceeded so slowly that only by the Spring of 1932 did the cutoff carry the main part of the divided flow.

Again, 15 miles upstream from Yucatan Bend the channel conditions at Davis Island and Diamond Point were variable and hence interfered with navigation. Davis Island has existed for more than 75 years, with the back channel (Palmyra Lake) maintaining itself sometimes as main channel. Meanwhile, Diamond Point, the projecting peninsula facing the upper end of the island, progressively narrowed down to a neck at its inshore end. Under these conditions the commission, with Gen. Brown's approval, decided to make a cutoff, having previously found favorable results in experiments on a model.

Under rather different conditions two cutoffs have been made below and above Natchez, at Glasscock Neck and Giles Bend. Here the river slope is irregular, there being a localized steep slope, and the cutoffs are expected to smooth out the slope and thereby increase the total channel capacity.

In taking the radical step of shortening and straightening the river's course by cutoffs, the engineers have followed the plan of beginning at the downstream end of the river section chiefly concerned. The river profile, Fig. 2, shows a fairly uniform flat slope below the Red River and a much steeper uniform slope above this point. A slope irregularity, simulating a reef, occurs in the transition section, just below Natchez. Removal of this irregularity may assist in carrying the flat slope of the Red River-Gulf section upstream, leading to a progressive improvement of slope and capacity of the upper section.

It is worth noting in connection with this slope question that below the Red the Mississippi River is quite stable, especially below a point some distance above Baton Rouge, while above Natchez its windings are unstable. How this difference depends on the soil character, slope and cross-section of the lower section, on the relative uniformity of flow resulting from diversion of flood peaks through the Atchafalaya and on differences in detritus movement remains to be investigated.

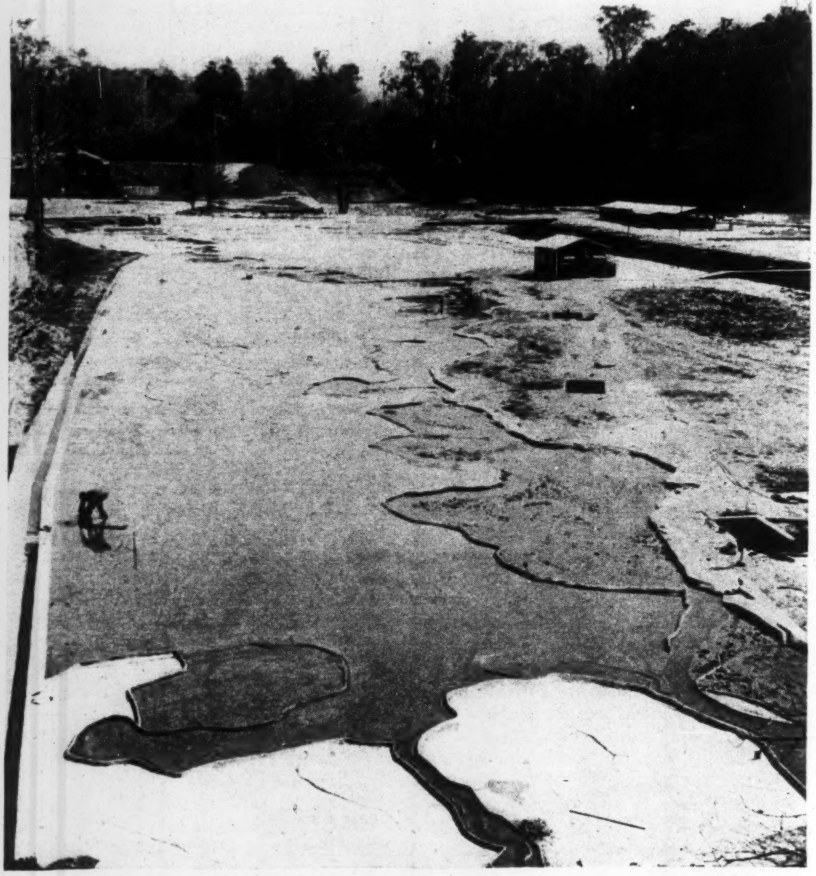

Fig. 8—Model through which the effect of cutoffs was studied at the Waterways Experiment Station.

Detritus movement

Erosion and deposition by the river have usually been correlated with the amount of sediment that it holds in suspension. But the channel deposits are largely sand, occasionally gravel. When the new studies of river action were begun, this fact soon attracted attention, and the character and amount of detritus or "bed load," as well as the way in which it moves, were investigated. It soon developed that bed load is likely to prove a determinative element in the hydraulics of the river.

Field observations showed that there is a large volume of bed load, that it is in intermittent movement, that it consists of coarse material (sand and larger particles rather than silt), and that it is identical with the raw material of bars and towheads (bars projecting above water and covered with brush). They indicated also that its movement is related to flow velocity. Use of oat grains as artificial detritus was an interesting feature of these experiments.

Two important conclusions emerged from the work: (1) The transporting power of the water is a function of depth, being greatest in the thalweg and less on the sloping sides of the cross-section. (2) The bed load moves in small jumps rather than in even flow, and some of the jumps are across and not along the current, so that *the detritus tends to move away from the filaments of highest velocity toward the regions of low velocity.*

The first conclusion has been verified by experiments with sand, gravel and concrete blocks. The second conclusion has been checked in part by flume experiments on heavy detritus, but more fully by observation of deposit and bar formation in the various model river-channel experiments. Both conclusions are regarded as highly important in respect to practical river operations, though the second one has most far-reaching relation to the entire complex of river problems. Practical application of the transporting-power principle is being made in the agitation dredging on the lower Atchafalaya and in connection with work on artificial riprap revetment.

Extensive field work in sampling bed-load material to determine its amount and character was resumed this spring after preliminary work last fall. In conjunction with observations on where the material is deposited, these investigations are expected to contribute important data to knowledge of how the river shapes its channel.

One of the tentative conclusions of the commission engineers is that the reaction between the flowing water and the moving bed load not only determines where deposits are formed but also determines the points of erosion attack of the water and is the initial cause of the tendency of a straight reach to meander. By control of amount of bed load (if this can be accomplished) they therefore hope to be able to reduce the instability of the stream.

Specific experiments in disposal of bed load have been based on the observations outlined. How the transported material divides at a point of division of the channel, as at the head of an island, has been studied in detail, with the finding that most of the material (a definite proportion) goes into the back channel, whose depth and velocity is less than that of the main channel; the main flow appears to push the detritus out of its way and into the back channel. This effect should cause all chutes and back channels to fill up quickly. The fact that in certain instances this is not the case has been traced to the geometrical form of the point of the island as governing the turbulence and cross-currents at the division of the flow. Tests of particular cases by models have shown that modifying this point through a dike carried upstream will cause the detritus to go into the minor channel.

It is planned to utilize this automatic filling of chutes both as a means of eliminating divided-channel conditions and thereby improving the flow of the stream, and as a means of getting detritus out of the river in order to prevent its deposition downstream and the resulting tendency of the river to attack its banks.

Revetment investigations

The above-noted matters relate primarily to river hydraulics as bearing on flood-carrying capacity and stabilization. Their full development is expected to minimize the necessity of protecting the river banks by revetment. Heretofore it has been believed that for ultimate stabilization of the river it would be necessary to revet about half the length of either bank—a revetment section on one side beginning approximately opposite the end of the section on the opposite side. If sufficient improvement of flow conditions can be attained and the disturbing effect of bed-load movement so controlled as to reduce erosive action, less revetment obviously will be required.

In the meantime, however, revetment remains the most formidable item in the completion of the project. Current types (articulated concrete-slab construction) range in cost from $250,000 to $500,000 per mile, and their life is limited. A survey of existing revetments by divers a year ago brought to light so many instances of rapid deterioration that the prospective cost of maintaining the banks in adequately protected condition appears excessive, even apart from the high initial expenditure necessary to complete the full length of revetment necessary. Search for more effective and cheaper types has therefore been active.

Spur-dike contraction works

From the viewpoint of stabilization, conditions in the alluvial river are essentially different in the section lying between Cairo and the mouth of the Arkansas from those prevailing below the Arkansas. The former section has generally smaller depth over the bars, on some of which dredging during low water is always necessary to maintain the navigable channel, and has on the whole a flatter cross-section, with greater tendency for lateral deposits to form and shift the channel. In this section stabilization is primarily a matter of holding the navigable channel against rapid shifting, and only secondarily, as a result of the former, of reducing the attack on the banks. In the lower section, on the other hand, the greater general depth makes dredging virtually unnecessary and causes bank stabilization and general hydraulic correction to be the major considerations. In consequence stabilization is being handled by different methods.

In the Memphis engineer district, which extends down to the Arkansas, the plan of controlling the navigation channel by contraction through spur dikes has been adopted, on the strength of its success on the Missouri and in the St. Louis district of the Mississippi. Detail application of dike protection has proved to require the help of model experiments in certain cases, in order to define the best location, length and number of dikes for development of a stable navigation channel of adequate depth between them, and for satisfactory sand deposition in the spaces between the dikes. Properly utilized, they operate to stabilize the river so effectively that the channel formed by them is not destroyed in flood time.

Testing for Diatomaceous Earth

By J. L. Heitzman and A. S. Peiper
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THE DETECTION of the presence of diatomaceous earth in set concrete is rendered difficult by the fact that neither visual inspection nor chemical analysis will yield results. Visual inspection fails because the usual methods of pulverization of the sample destroy the form of the characteristic frustules of the diatomite. The writers, therefore, set out to develop a method of preparing a sample, which under the microscope would show the triangular, fan and complicated shapes of diatomaceous earth. This finally was accomplished by a procedure involving disintegration of the concrete by rapid cooling from a high temperature.

The sample to be examined is first broken down into pieces 1 to 2 in. in daimeter. These are heated for about one hour in an iron disk or muffle at about 800 deg. C. and then plunged into cold water. This treatment, as a rule, will disintegrate the concrete, which is then allowed to settle. The liquid is carefully decanted, and several drops are placed on slides and examined under magnifications of 200, 400 and 600 diameters. Diatoms are often found without any further treatment. If not, however, a small amount of the disintegrated concrete is shaken with distilled water. After allowing the heavier sand to settle out, the turbid solution is examined microscopically for diatoms. Finally a representative portion of the disintegrated concrete is heated in a 10 per cent solution of hydrochloric acid. (The sample should not b subjected to boiling or prolonged acid treatment, as there is the possibility of the acid attacking or destroying the frustules.) The solution is then filtered and washed, and the residue on the filter is examined microscopically. Diatomaceous earth, if present, will be manifested by the characteristic forms. Using this method, it is possible to detect as little as one-half of 1 per cent of diatomaceous.

In many cases the first step, that of examining the decanted solution, is all that is necessary. It is also a precaution against loss of the diatomaceous earth in the decanted liquid. The second step is designed to save time, but the fact that no diatoms are disclosed during the first two stages of the examination is no indication that they are not present, as the cells or frustules may be obscured by the cement. Hence treatment with dilute acid to dissolve the cement renders the detection a simple matter.

Trestle Design to Resist Rio Grande Floods

In 2,200-ft. American approach to bridge at Del Rio, Tex., continuous steel-girder construction is used in a 200-ft. section next the river while elsewhere pile bents are used braced by a concrete sill and galvanized cable diagonals

By J. W. Beretta
San Antonio, Tex.

RECONSTRUCTION of the long American approach to the international highway bridge between Villa Acuña, Coahuila, Mexico, and Del Rio, Tex., has resulted in a structure of several unusual features. Maximum economy, rapidity of construction and the existence of pile bents, broken off at the ground level, and of a large amount of old timber from the original approach influenced the type of design developed. A part of the new approach is of steel-bent and a part is of pile-bent construction. In both types of bents special precautions were taken to insure against overturning by floods and damage by driftwood. Continuous-girder construction features the steel section of the approach, while in the timber section the use of galvanized cable crossbracing and a concrete sill at ground level are notable.

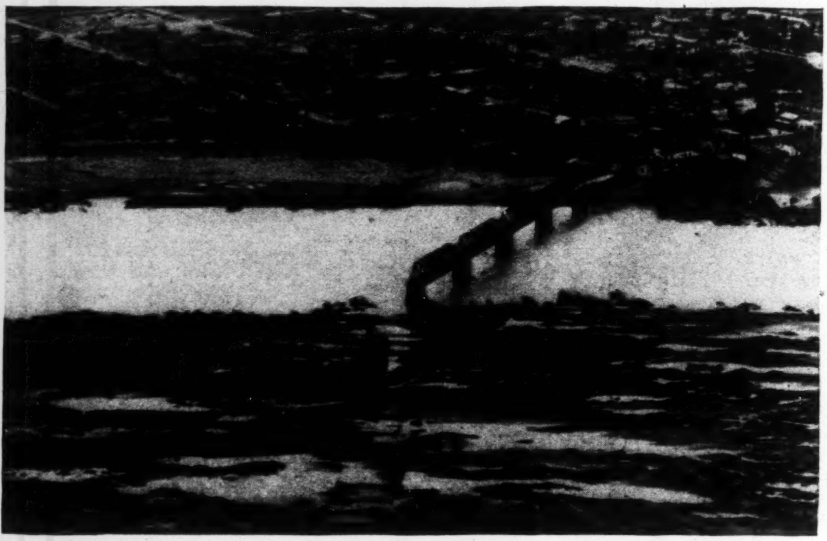


Fig. 1—Del Rio bridge after the Rio Grande floods of September, 1932, showing the location of the American approach, which has been replaced with a trestle designed to withstand heavy accumulations of drift and a 30-m.p.h. current.

A description of the unprecedented flood that destroyed the original bridge approach was published in *Engineering News-Record*, Nov. 10, 1932, p. 557. Out of an original length of 3,000 ft. of wood-trestle approach, only 600 ft. remained nearest the shore, and this was in partly damaged condition. Examination of the site revealed that the failure of the bridge was progressive from the steel river spans (Fig. 1) to the shore, the immediate cause of failure being the deficient bracing of the creosoted three-pile bents. These could not withstand the severe current and large amounts of driftwood and consequently were broken off at the ground level, allowing the structure to float down the river. Much of the material was later recovered from the riverbed below the bridge site and used in the reconstruction.

In order to reduce the chances for future destruction from similar causes, careful design thought was given to the new approach. The maximum velocity of current and greatest amounts of driftwood during the September floods were noted at the juncture of the old timber approach and the steel truss spans on the American side. Beginning at this point, therefore, it was decided to place a length of about 200 ft. of steel-girder spans designed to withstand severe conditions. The remaining 2,200 ft. of bridge approach was rebuilt of timber, matching the spans and dimensions of the old bridge. The entire bridge approach, both steel and timber, is about 23 ft. above the ground surface.

The new steel section of the approach is a half-through girder bridge, continuous over four supports, with a total length of 205 ft. The girders, which span about 68 ft. each, are 36-in., 230-lb. sections. The floor beams are of steel, but the joists and flooring are of timber designed for a standard H-10 loading. The roadway is 18 ft. wide in the clear and is protected by high rugged timber wheel guards. A single 4-ft. sidewalk is carried on

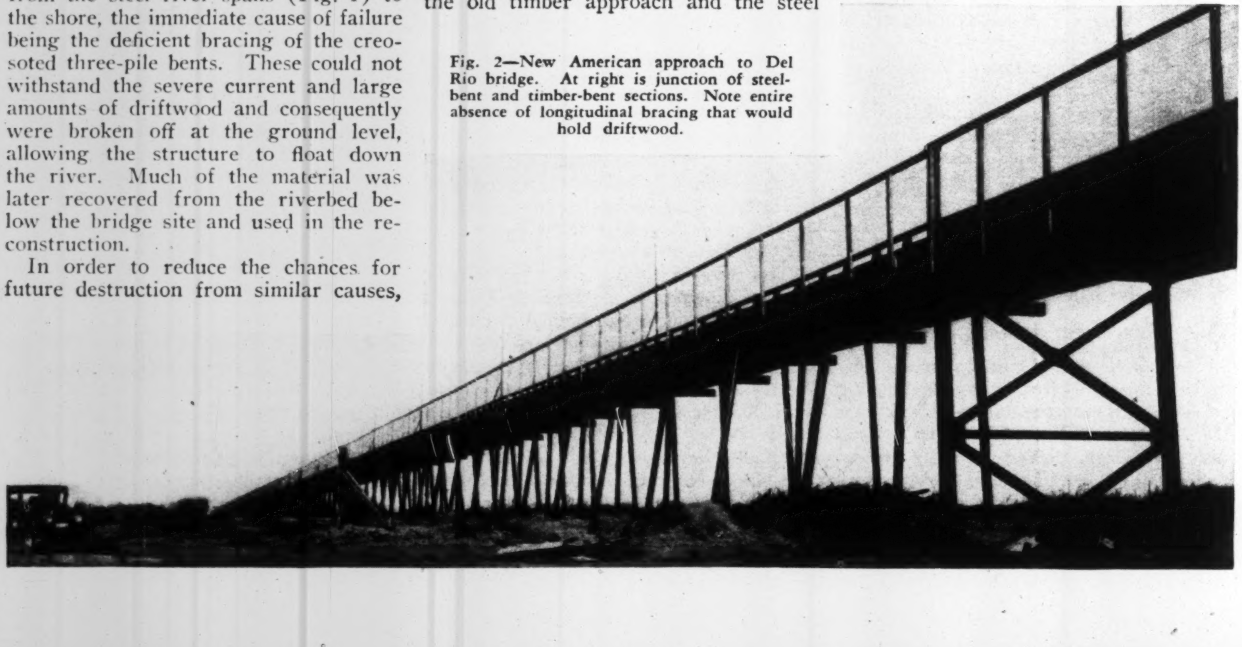
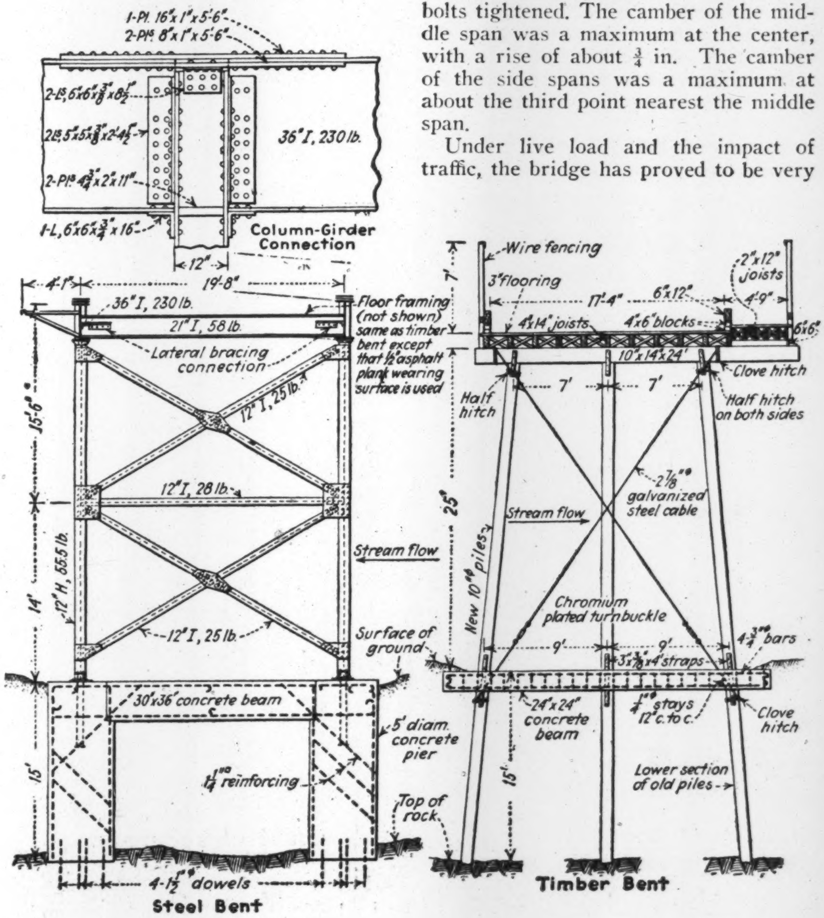


Fig. 2—New American approach to Del Rio bridge. At right is junction of steel-bent and timber-bent sections. Note entire absence of longitudinal bracing that would hold driftwood.

brackets on the downstream side. Railings 7 ft. high covered with wire fencing are carried at either side of the structure. An asphalt-plank wearing surface is used for both the roadway and the sidewalk.

One end of the steel structure rests on the reinforced-concrete pier, which also supports the end of the existing trusses of the river spans. The other three supports are heavily braced steel bents into which the girders are rigidly connected at the ends to provide continuity. Transmission of top-flange tension is by means of riveted splice plates. The bottom-flange compression is transmitted through a plate welded into the column in direct line with the girder flanges. No diagonal bracing is used perpendicular to streamflow, the continuous construction of the deck being relied upon for longitudinal stability. The steel bents are carried on portal-braced reinforced-concrete caissons resting on, and doweled into, bedrock about 16 ft. below the surface of the riverbed. All parts of this structure are designed for rigidity and strength sufficient to resist complete submergence, large amounts of driftwood and a current velocity of 30 miles per hour.

Fig. 3—Details of trestle construction. Steel bents support three spans of continuous rolled girders. Timber bents are braced transversely by a concrete sill beam and galvanized cable diagonals.


1-Pl. 16"x1"x5'-6"
2-Pl.s 8"x1"x5'-6"
2-Ls, 6"x6"x3/8"x8 1/2"
2Ls, 5"x5"x3/8"x2'-4 1/2"
36" I, 230 lb.
2-Pl.s 4 3/4"x2"x11"
1-L, 6"x6"x3/4"x16"
Column-Girder Connection
12"
4'-1"
19'-8"
36" I, 230 lb.
21" I, 58 lb.
Floor framing (not shown) same as timber bent except that 1/2" asphalt plank wearing surface is used
Lateral bracing connection
12" I, 25 lb.
15'-6"
12" I, 28 lb.
Stream flow
14'
12" H, 55.5 lb.
12" I, 25 lb.
Surface of ground
30"x36" concrete beam
5' diam. concrete pier
1 1/4" reinforcing
15'
Top of rock
4-1 1/2" dowels
Steel Bent
7'
Wire fencing
3" flooring
17'-4"
6"x12"
2"x12" joists
4'-9"
4"x14" joists
4"x6" blocks
6"x6"
10"x14"x24'
Clove hitch
Half hitch
7'
7'
Half hitch on both sides
25'
2 7/8" galvanized steel cable
Stream flow
New 10" piles
Chromium plated turnbuckle
9'
9'
4-3/4" bars
3"x3/8"x4' straps
24"x24" concrete beam
1/4" stays 12" c. to c.
Clove hitch
15'
Lower section of old piles
Timber Bent

In the shop fabrication a combination of both welding and riveting was used, but in the field all connections were riveted. A gin pole was the principal piece of erection equipment required. Shop and field paint contained portland cement pigment as a special protection against corrosion.

The method used to supply camber to the rolled sections in the field, by the introduction of fixed-end moments after erection, is unusual and is believed to be original. The beams constituting the center span were fabricated with beveled ends so that the top flange was $\frac{1}{8}$ in. shorter than the bottom flange. In erection, the column bents were given a temporary outward batter; and the outside spans, whose inside ends were beveled $\frac{1}{16}$ in., had their outer ends temporarily supported on blocks 4 in. above their final position. This enabled the girder connections to be riveted up in full with the members in their temporary positions.

On completion of the bridge, the lowering of the outer girder ends into final position applied tension to the top flanges and compression to the bottom flanges, causing an upward camber following moment curves. The column bents were then plumbed and the anchor bolts tightened. The camber of the middle span was a maximum at the center, with a rise of about $\frac{3}{4}$ in. The camber of the side spans was a maximum at about the third point nearest the middle span.

Under live load and the impact of traffic, the bridge has proved to be very rigid and free from vibration. In effect, the structure is strictly continuous under dead load but utilizes the advantages of the rigid-frame connections of the column bents in carrying the live load. Due to the existence of both positive and negative bending moments in the girders, bracing is placed at the center of the web rather than at the bottom flange. This location also reduces the possibility of drift accumulating in the bracing during periods of high water.

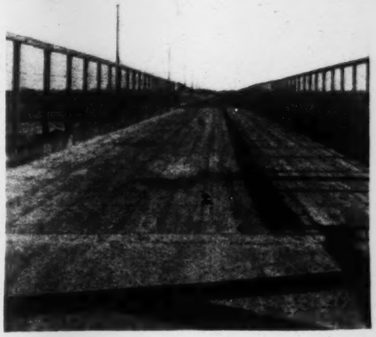


Fig. 4—Floor of steel-bent section has a wearing surface of asphalt plank on timber joists. Wire mesh railings are 7 ft. high.

Rebuilding of the remainder of the bridge followed conventional timber design for the floor system but utilized new departures in the bracing of the timber bents. The old creosoted piles remaining in the ground were first trimmed off level and square. Loops of $\frac{7}{8}$-in. galvanized-steel cable (double on the upstream pile and single on the downstream), forming the lower portion of the diagonal bracing, were securely attached to these pile tops. Two steel splice plates were then bolted to each pile top, and a 24-in. square reinforced-concrete sill was poured, completing the lower portion of the bent.

The upper portions of the bents were then added, consisting of 25-ft. lengths of piling resting in sockets provided in the concrete sills. These were connected to the lower pile sections by means of the steel splice plates protruding above the sills. Each bent was capped with a 10x14-in. Douglas fir timber, and the whole structure was tied together and braced with galvanized steel cables connected to the lower loops by means of galvanized turnbuckles. The upper ends of this diagonal cable bracing were tied around the timber cap as well as the pile top, giving the timber trestle strong resistance to floods. In fact, the upstream piling must be uprooted or the steel bracing cables parted before the bent will wash away. Excluding fire and decay, it is believed the timber portion will serve quite as satisfactorily as the steel trestle spans.

The timber spans are about 22 ft. long, with 4x14-in. fir joists supporting

3x6-in. yellow pine roadway planking. A live load consisting of a train of 6-ton trucks was assumed in the design. Dimensions and position of roadway, sidewalk and fencing are the same as on the steel spans. On account of the large amount of salvage timber used, no attempt, beyond creosoting the piles, was made to provide either protection or special roadway wearing surface for the wood-trestle part of the structure.

The total cost of the entire 2,400 ft. of steel and timber bridge construction was about $45,000, or $18.75 per linear foot. Design and supervision of this structure were undertaken for the owners, the Citizens Bridge Co., of Del Rio, Tex., by J. W. Beretta Engineers, Inc., of San Antonio, Tex., under the direction of W. E. Joor, vice-president. A. E. Wood, of the same firm, was resident engineer. The general contractor was Carnell Hill, Del Rio, Tex. Structural steel, cables and miscellaneous material were furnished by the Alamo Iron Works, and erected by J. B. M. Nash, both of San Antonio. The asphalt-plank flooring was furnished and placed by the Uvalde Rock Asphalt Co., San Antonio.

Destructive Earthquake Motions Measured for First Time

High accelerations in the Long Beach earthquake are shown by strong-motion accelerograph records at three stations in Southern California

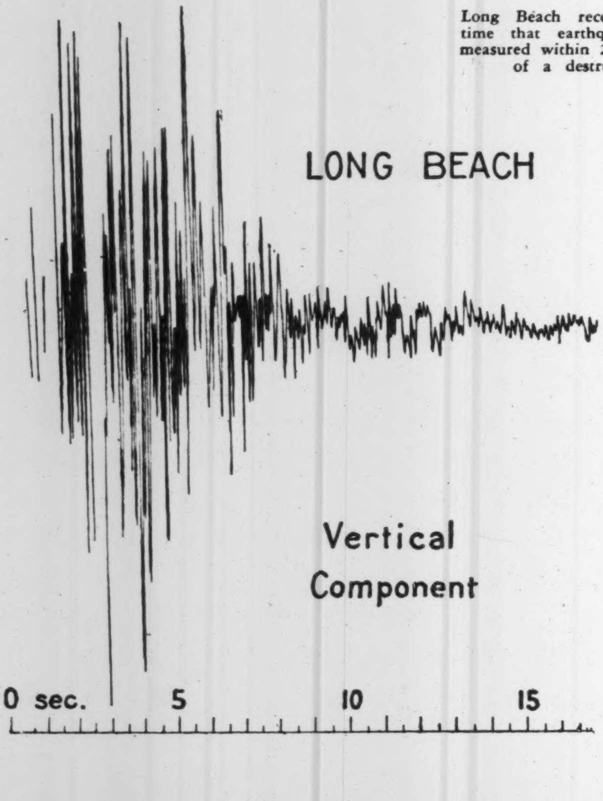
By N. H. Heck
Chief, Division of Terrestrial Magnetism and Seismology
and Frank Neumann
Chief, Section of Seismology, U. S. Coast and Geodetic Survey

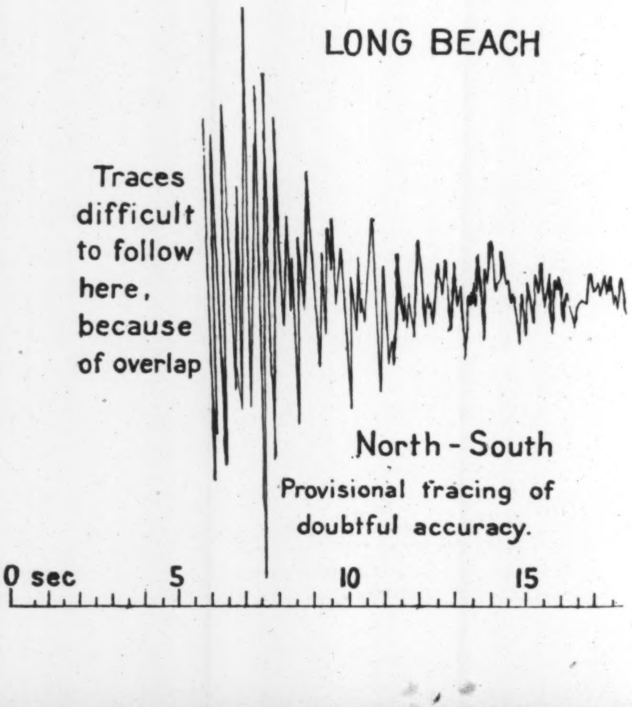
THREE MONTHS AGO at Long Beach, Calif., for the first time in the history of earthquake study, the acceleration of a destructive shock was measured at a distance of less than 20 miles from the point of origin. A short time before the destructive earthquake of March 10, 1933, the U. S. Coast and Geodetic Survey had completed the installation of three accelerograph stations in the Los Angeles-Long Beach area. Excellent records of the earthquake accelerations were obtained at these stations. The results are unusually important to engineers as well as seismologists in showing much greater acceleration than had been thought likely to occur in Southern California. They also give new data on periods and amplitudes of motions in both vertical and horizontal directions. The large vertical motions measured are especially significant.

According to Harry O. Wood, of the Seismological Research Laboratory at Pasadena, the epicenter of the Long Beach earthquake, which occurred at 5h. 54m. 8s. p.m., Pacific Standard time, was at 33 deg. 34.5 min. north latitude and 117 deg. 59 min. west longitude, or beneath the sea, about 3½ miles offshore from Newport Beach, Calif. He estimated the depth of origin of the strongest shock at about 10 km., or 6 miles. The distances from the epicenter to the Long Beach, Vernon and Los Angeles accelerograph stations are respectively 17, 33 and 37 miles.

The Long Beach station is in the basement of the strongly constructed Public Utilities Building, which went through the earthquake practically without damage; it is probable that the depth to rock here is considerable. The Ver-

Long Beach record represents the first time that earthquake motion has been measured within 20 miles of the epicenter of a destructive earthquake.





PRELIMINARY ANALYSIS OF ACCELEROGRAPH RECORDS OF THE SOUTHERN CALIFORNIA EARTHQUAKE OF MARCH 10, 1933

Component	Time	Maximum Trace Amplitude	No. of Waves*	Earth-Wave Period	Maximum Acceleration	Computed Maximum Displacement†	Computed Maximum Velocity	Remarks
	Sec.	Cm.		Sec.	Gravity	Cm.	Cm./Sec.	
Long Beach								
Horizontal	0-7+	3-4	3-4	1.5	0.11	6.0	25	The tabulated Long Beach horizontal movements are rough approximations only. Main portion of record impossible to read See text. Rigid parts of optical system suffered small periodic (?) movements during first few seconds, as shown by time marks on original record.
Horizontal	1-4+	7	Many	0.3	0.23	0.5	10	
Horizontal	8+	0.5 ±	5?	1.8	0.02	1.6 ±	6	
Vertical	0-6	2.0	2?	1.3 ±	0.07	3.0 ±	14	The record for this component can be almost entirely identified.
Vertical	0-5	4.0	30	0.11	0.25	0.07	4	
Vertical	Scattered	2.0 ±	Few	0.23	0.08	0.10 ±	3	
Vertical	8+	0.3 ±	5?	1.8	0.01	0.8 ±	3	Note synchronous movement on horizontal components.
Vernon								
N-S	0-1	2.2	1	0.7	0.07	0.9	8	
E-W	0-1	3.0	1	0.7	0.11	1.4	12	
Resultant	...	...	...	0.7	0.13	1.7	15	NW-SE motion (longitudinal with respect to bearing of epicenter).
N-S	1-2	4.3	1	0.7	0.14	1.7	15	
E-W	1-2	4.3	1	0.7	0.15	1.9	17	
Resultant	...	...	...	0.7	0.21	2.6	24	NE-SW motion (Transverse). Interpretation not beyond question but seems highly probable.
N-S	3-15	0.8	3?	2.5	0.02	4.0	10	The 3-15-sec. group is confused. The longer-period wave dominates, and the major movements are nearly synchronous on the two components. After 15 sec. they are not, indicating rotary motion, and resultant values are consequently not given.
E-W	3-15	0.8	3?	2.5	0.03	4.0	10	
Resultant	...	...	...	2.5	0.04	6.0	15	
N-S	9	0.6	1?	1.5	0.02	1.0	4	
E-W	9	0.8	1?	1.5	0.03	1.6	7	
Resultant	...	...	...	1.5	0.04	1.9	8	
N-S, E-W	3-15	...	...	0.7	...	...	...	Strong evidence. Note first waves of same period.
N-S, E-W	0-6	3.0	Many	0.23	0.10	0.12	3	Only a few waves of the high tabulated value, mostly on E-W
	0-15	...	...	0.35	...	...	...	Some evidences of this period, but relatively insignificant.
Vertical	0-3	0.9	2	1.0 1.4	0.03	0.8	5	
Vertical	3-0	...	5	1.25	...	...	...	
Vertical	0-5	1.0	Many	0.13	0.05	0.02	1	
Vertical	0-5	1.5	...	0.25	0.05	0.08	2	Difficult and doubtful.
Los Angeles								
NW	0-6	0.8	3	1.5	0.03	1.5	6	Mostly on one component. Longitudinal wave?
NE	2-6	1.4	6	0.62	0.05	0.5	5	Mostly on one component. Transverse wave?
NW	5-7	0.6	6	0.40	0.02	0.18	2	
NW	7-9	1.2	2	1.0	0.04	1.0	6	A complex wave evidently not synchronous on two components. Rotary.
NE	7-9	1.6	1	1.0 1.6	0.06	1.5, 3.9	9, 15	
NW	9-12	...	6?	0.4	0.03	...	...	Relatively small waves.
NE	9-12	...	4	0.8	0.03	...	...	Relatively small waves.
NW	11-18	0.5?	?	2.5	0.01	2.4	6	This wave better defined on NE component. Badly distorted and open to question.
NE	12-15	1.0	2?	2.5	0.04	6.0	15	
NE	14-17	0.6	...	1.2	0.02	0.8	4	
NW	17-21	0.7	2	1.5	0.02	1.3	5	
NE	19-21	0.5	1	1.5	0.02	1.1	5	
NW	20-30	0.2	2?	4.8	0.01—	3.6	5	
NW-NE	0-10	0.7	Many	0.12	0.02	0.01	0.5	Superimposed tremors.
Vertical	2-8	0.3	4	1.0	0.01	0.3	2	Series not continuous.
Vertical	8-9	0.5	1	1.5	0.02	0.9	4	
Vertical	0-10	0.4	Many	0.2	0.02	0.02	0.5	Superimposed tremors.

*Waves of significant amplitude. †One-half total range of ground movement.

non station (for convenience named after the near-by section of Los Angeles) is in the Terminal Building of the Central Manufacturing District, Inc., a large structure that was damaged by the earthquake; this station is probably on deep alluvium. The Los Angeles station is on a platform in the Subway Terminal Building, which is stated to rest on rock.

All records were obtained on accelerographs *(ENR,* Sept 8, 1932, p. 288) with Wenner accelerometers, McComb-Parkhurst automatic recorders, and Braunlich starting devices (except for Los Angeles, where a pendulum starting device was being tested. It should be understood that the time is relative and that there is no means provided for putting absolute time on the record; it may be assumed that the record started very soon after the shock reached destructive intensity. For periods in excess of 0.4 sec., 1 in. of amplitude on the record corresponds to approximately 0.085g acceleration, the amplitude being measured to one side of the position of rest. It should be clear that the maximum values of acceleration, displacement and velocity referred to in this report represent maximum values for simple harmonic motion. They are not average values.

Long Beach record

The Long Beach record should be considered in the light of its being the first of its kind ever obtained so near the epicenter of a destructive earthquake. In view of lack of experience and previous test by earthquake, certain precautions to prevent too serious overlap of the records of the different components, which have since been adopted, had not then been taken.

The vertical record has been separated almost in its entirety, subject perhaps to some uncertainty in the high-acceleration short-period portion of the record. One difficulty is that the high accelerations caused such rapid movements of the light spot that only the turning points were recorded. In the case of the horizontal records the light spots when at rest were too close together, and it is very hard to verify the turning points; but in the case of the vertical components a peculiar twist at the turning points enables them to be distinguished.

However, certain conclusions may be drawn from the horizontal records, which represent considerable advance over the previous complete lack of knowledge. The following statements rest on the basis of the best judgment possible and are not so conclusive as those derived from the components that were completely separated.

Long Beach horizontal records—Working backward from the portion of the horizontal record shown into the short-period high-acceleration portion, there appears to be a dominant period of 0.3 sec. If we accept this period for the larger movements, and a trace-amplitude of 7 cm. (such turning points are visible in the original records, as at 1 and 4 sec. from beginning), the corresponding acceleration is 0.23g, and the estimated ground displacement (one-half range) is 0.5 cm. However, this value of the trace-amplitude may be seriously in error, as it is measured from the position of rest and not from the mean trace of a long-period wave on which it is undoubtedly superimposed.

We must accept with regret the view that the presence of high accelerations of short period, combined with overlapping of the records, makes it practically impossible to identify waves of large period in the early portion of the record. However, in some portions of the record it can be seen that certain turning points come in groups that seem more or less periodic; these may be interpreted as indicating the turning points of recorded waves of 1.5 sec. period, and for such a wave examination warrants the estimate that, after eliminating the wave of 0.3-sec. period, we have a trace-amplitude of 3 or 4 cm., corresponding to a ground displacement of 6 cm. The corresponding maximum acceleration is about 0.11*g*.

It must be understood that the two accelerations 0.23*g* and 0.11*g* must not be added. If these values correctly represent the accelerations on one component, there is possibility (since it appears that the amplitudes on the two components are not greatly different) of resultant accelerations 1.4 times as great.

In the part of the horizontal record after the first 8 sec., waves of 1.8 sec. appear, with .02 to 0.3*g* acceleration.

Long Beach Vertical Record—As has been stated, the vertical component has been almost entirely identified and separated; it can therefore be discussed in more detail than the horizontal. In the first second there is considerable uncertainty. An outstanding feature of this record is that the vertical movements are quite comparable to the horizontal. The periods are not the same as for the horizontal records. (This is also true for the Vernon and Los Angeles records.) The record may be regarded as made up of a train of waves of periods 1.0 to 1.5 sec., with waves of periods 0.1 to 0.2 sec. superimposed; the latter have great trace-amplitude during the first 5 sec.

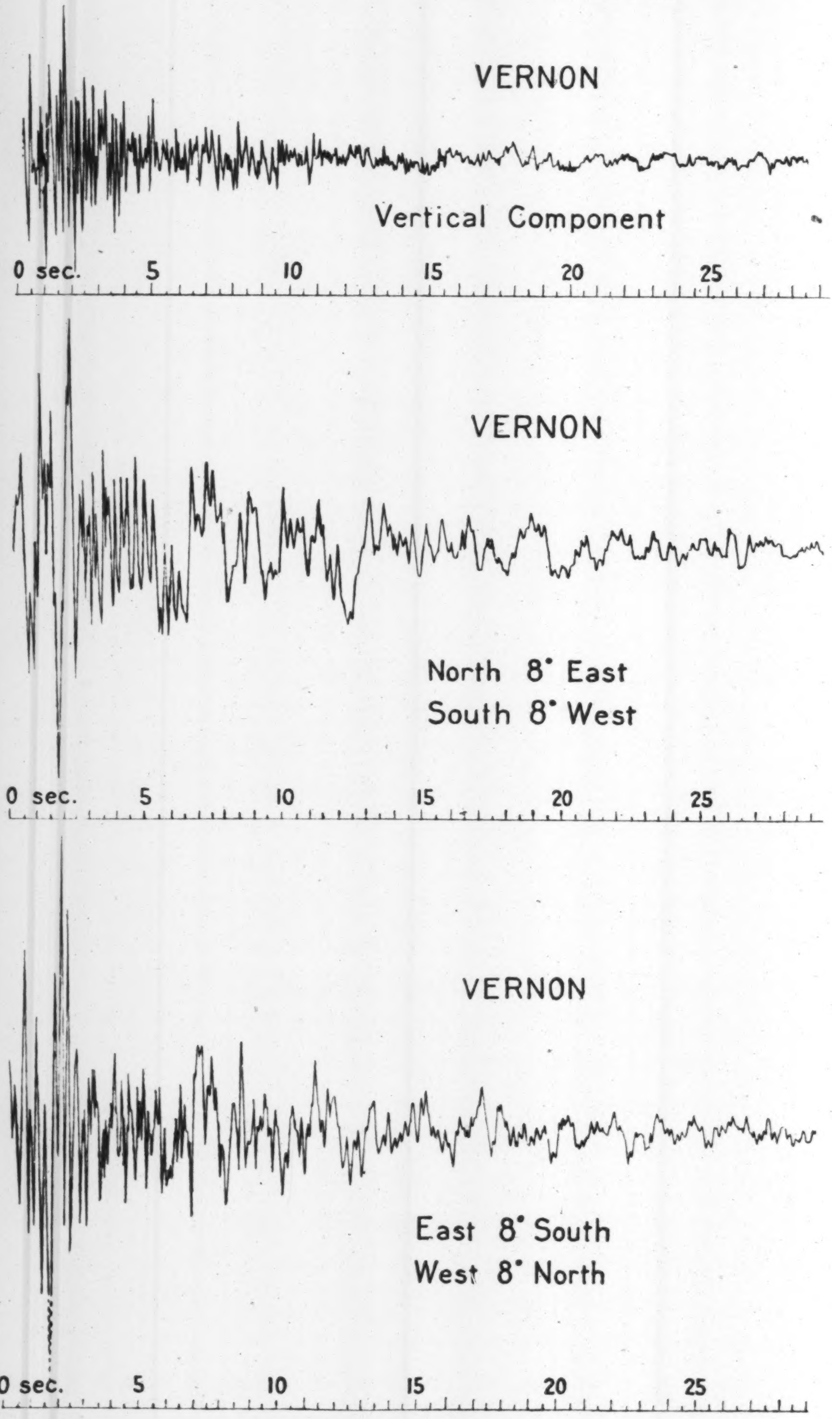
The average period of the short-period vertical waves is 0.11 sec., and there is some evidence of others of 0.23 sec. It seems from the record that, after eliminating in so far as possible the effect of the longer-period waves, the larger trace-amplitudes were close to 4 cm., which is the observed maximum; it may have been larger in places where the light spot may have gone off the sheet.

It should be understood that *the records do not give ground displacements,* and displacement meters were not yet in place at the time of the earthquake. However, it is possible to compute displacement from the period and acceleration of sustained harmonic motion, and accordingly the ground displacements for earthquake waves may be estimated on this assumption, but it must be recognized as only a rough approximation. It is for this reason as well as others that displacement meters are necessary, and we need simultaneous direct measurements of acceleration and displacement before satisfactory conclusions on destructive earthquake action can be drawn. Future observations will enable us to appraise the value of the displacement results given in this report.

When the period is less than 0.3 sec., the trace-amplitudes do not give the accelerations directly, but the latter can be computed by well-known seismological methods.

The short-period vertical accelerations at Long Beach compose the dominant part of the record in so far as trace-amplitude is concerned. There were possibly 25 to 35 vibrations during the first 5 sec., with average acceleration about 0.7 the computed maximum of 0.25*g*, or 0.18*g*. These, however, correspond to a computed ground dis-

Accelerogram tracing of earthquake in the Vernon district of Los Angeles. Short periods and high accelerations (0.1*g* horizontal and 0.5*g* vertical) secured in the first 6 sec.



placement of less than 1 mm. There are scattered waves of 0.23 sec. period with computed maximum acceleration of 0.08*g*.

Long-period vertical accelerations—as in the horizontal components of the waves, the short-period vibration is superimposed on waves of period of about 1.3 sec. While these latter are not identified with quite the same certainty as for the other stations the conclusions are not greatly in error. The maximum acceleration for these waves is about 0.07*g*, with a ground displacement estimated as 3 cm. Two such large-amplitude waves are indicated. After 8 sec. there appear waves of 1.8-sec. period, with 0.01*g* acceleration.

In all the records there is evidence of rotary motion, representing sudden changes in direction of the waves, which in turn are probably due to change in type of the arriving waves.

Vernon record

Though the traces of vertical and horizontal components in the Vernon record are a little difficult to separate, it is believed that this has been completely accomplished. Study of the records and the table will enable anyone interested to draw his own conclusions, and only the special points of interest will be pointed out.

Short-period waves of 0.23 and 0.35 sec. and of maximum acceleration about 0.1*g* are found in the first 6 sec. for the horizontal components; in the case of the vertical component, periods of 0.13 to 0.25 sec. with 0.05*g* acceleration. The highest acceleration is that of the 0.7-sec. period waves, which appear to be longitudinal during the first second, with maximum acceleration of 0.13*g*, and transverse during the next 2 sec., with maximum acceleration of 0.21*g*. Later waves have periods of 1.5 to 2.5 sec., with accelerations of 0.02 and 0.03*g*. One of the waves of 2.5 sec. apparently corresponds to a maximum ground displacement of 6 cm.

In the vertical record the prevailing periods are 1.0 to 1.4 sec., with approximate maximum accelerations of 0.03*g*.

The same general type of waves continues throughout the record, with progressively less amplitude.

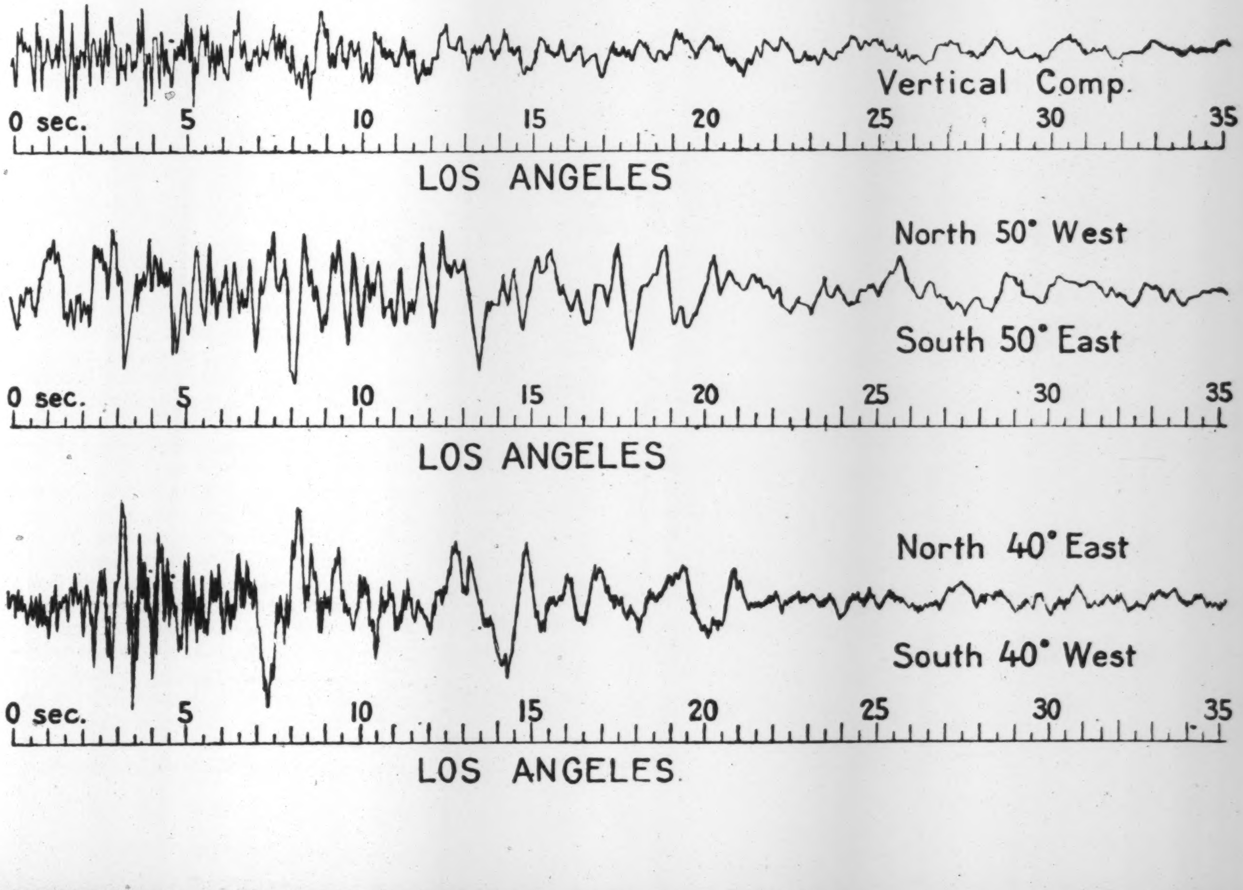
Los Angeles record

At the distance of the Los Angeles station the horizontal record has become the predominating feature of the record, and the duration of the principal portion is already greater than at Long Beach. It will be seen from the table that, while there is wide variation in periods and accelerations, the prevailing waves are from 1.0 to 2.5 sec. period, with maximum acceleration of about .06*g*, the latter being associated with waves of about 1-sec. period.

It should be noted that while the accelerations are apparently small, they are all within the destructive range, according to the Cancani scale. The computed ground displacements are on the order of 3 to 4 cm., but there is one wave of 2.5-sec. period with computed ground displacement of 6 cm. (one-half range). Attention is again called to the uncertainty of these computed ground displacements.

Resonance — The question of resonance, that is, of a series of waves of the same period that might set a tall building of similar period into dangerous vibration, is specially important at this station because of the existence of buildings of this type in the vicinity. (At Long Beach the question of resonance is also important, as there are a number of tall buildings, but the character of the record is such, due to proximity of the epicenter, that definite conclusions cannot be reached.) In the first 6 sec. there were three waves of about 1.5-sec. period with computed ground displacement of 1.5 cm., and a group of six waves of 0.6-sec. period with computed maximum ground displacement of 0.5 cm., but in the other portions of the record there is change of period throughout.

In the later part of the record, after 20 sec., there are several waves of about 4.8-sec. period and acceleration of 0.006*g*. The probable ground displacement is on the order of 4 cm., or 7-cm. range.



On the Los Angeles instrument, 37 miles from the epicenter, horizontal movements predominate.

The Wide Boulevard— Its Design and Control

Heavy traffic arteries require careful design and a carefully tuned-up control system for maximum efficiency, without which the economics suffer severely

By J. Rowland Bibbins
Consulting Engineer, Washington, D. C.

TWELVE YEARS AGO street-cars were permitted, under order of the Illinois Commerce Commission, to be laid in or along Lake Shore Drive from Chicago Ave. south five blocks to the municipal pier. This was done, without objection by the Lincoln Park Board, as a temporary measure to serve the Pageant of Progress held on the pier, 16 days in 1921 and 23 days in 1922, but the street-car company held to its temporarily acquired right-of-way. In 1926 the Illinois Commerce Commission denied the Lincoln Park petition for removal, but a rehearing was requested; since that time the matter has been before the commission, which on Dec. 2 of last year again denied the petition, asserting that the tracks are necessary in the interest of public convenience. The city of Chicago and civic organizations were aligned with the street-car company. Had it not been for the projected new Outer Drive, which must utilize Lake Shore Drive as an approach to the Outer Drive Bridge over the Chicago River, the street-cars could continue without protest. The matter has now been concluded so far as the commission is concerned, after the taking of 5,800 pp. of transcript and several hundred exhibits over a period of six years; but an appeal to the Circuit Court will be taken by Lincoln Park. J. Rowland Bibbins and Hugh E. Young were retained as consulting engineers by Lincoln Park, on whose property the street-car company was laid. R. F. Kelker represented the city, and E. J. McIlraith the car company. More than twenty counts of traffic on Michigan Ave. and other pertinent points were made by Mr. Bibbins. The movements of more than 238,000 people were checked. The following article gives a long-time view on certain phases of the economics involved in wide boulevard design, with some pertinent queries as to economic city planning, transportation technique and financial limitations.
—EDITOR.

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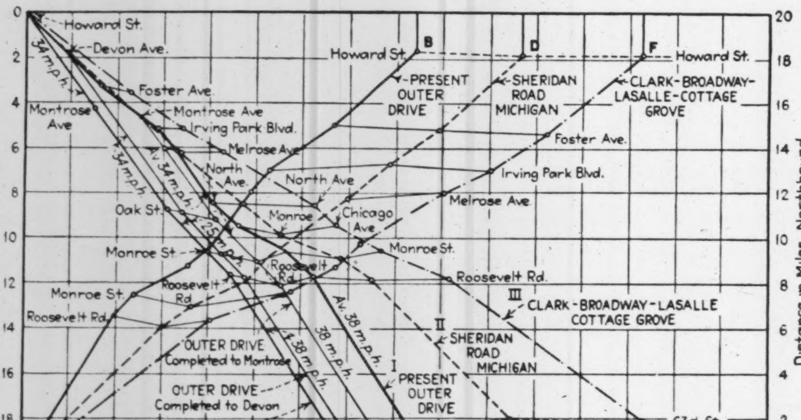
RECENT CONCLUSION of a comprehensive study of lake front traffic at Chicago has brought new emphasis upon the growing economic problem of the wide traffic thoroughfare, its best design, what type of traffic control will preserve the necessary freedom of movement and minimize stoppage and delays and also will insure adequate rush-hour capacity and safety for pedestrians. The same problem confronts Washington in the new Constitution Ave. (widened B St.) and is ever-present on wide Pennsylvania Ave.

Normal speeds obtained on Outer Drive, Chicago, and inside routes from Howard St. on north side to 63d St. on south, 18 miles. Average of morning and evening rush and non-rush speeds



While there are few arteries paved 100 ft. wide or more, they are always of immense strategic importance in the traffic system of a city. City planners have encouraged these wide highways, but little study has been given to design and particularly methods of controlling traffic on them. As a result, stop-lights or police control have been used as an emergent measure, but it is quite apparent that a large part of the capacity and real utility of such a major transport facility must be sacrificed because of the necessary time required for a *full* crossing of such a heavy traffic way. And the large capital investment in such projects is similarly jeopardised. Instead of a transportation highway of large capacity, high speed and great public convenience, the necessary controls may reduce its real value actually to less than a free thoroughfare of one-half or two-thirds its width.

Heaviest traffic artery

Chicago lake front traffic fortunately can be measured largely at the Michigan Ave. bridge, which carried about 71,000 vehicles per day on the upper deck (excluding buses), or around 85,000 on both decks (estimated). This is more than the New York bridges and more than twice that of the Holland Tunnel traffic. This traffic has doubled since the bridge was opened in 1920 and still holds up despite the depression. It is probably the heaviest traffic artery in the world. Originally designed as a traffic "header" for speed and as a comfortable bypass around the central business district, it is now so congested as to warrant the new "Outer Drive," or the connecting link between the South Shore and North Shore highways extending from Jackson Park on the south to Rogers Park or Evanston on the north, a distance of 18 miles.

From a typical origin-destination count it appeared that bridge traffic reaches all parts of the city, although more concentrated along the lake front wards. It is thus a city-wide more than a local improvement, contrary to the usual view. During rush hours this 6-lane bridge handled as many as 3,100 automobiles (plus buses) in north-bound direction, with an average lane density of over 1,000 and a maximum of about 1,300 for any lane (maximum 30-min. hourly rate). However, only 16 per cent of the bridge traffic was found to originate in the central district during the six heaviest hours of the fourteen-hour check, the rest (84 per cent) being through bypass traffic to and from all parts of the city.

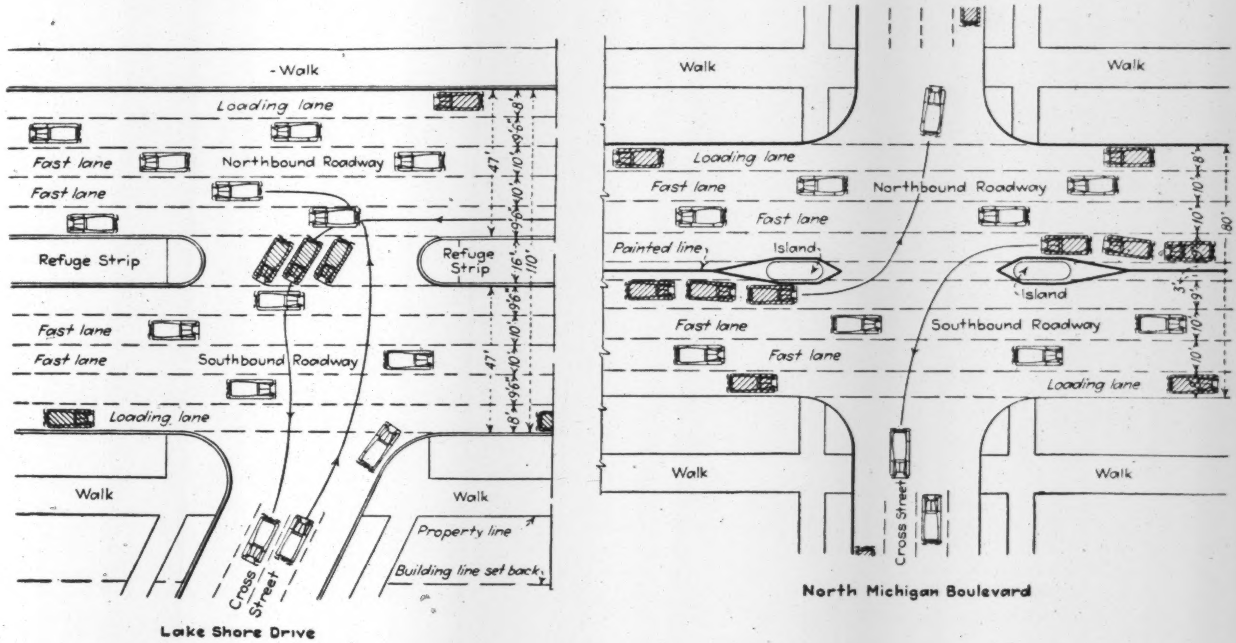
Signals slow up system

This traffic and density was achieved in spite of a synchronized signal system on the boulevard, with different cycles and splits north and south of the bridge, the cross intervals taking from 52-60 sec., or 35 per cent of the cycle time, during which all main traffic on the avenue was arrested about every 2-1/4 min. This signal system produced an obvious "cycle jam" at bridge heads every 10 min. and a minor one every 5 min., with serious congestion. During these rush periods the average speed along the approaches reduces to around 6 m.p.h., sometimes less.

On the free-running sections, such as the completed South Shore Drive, average speeds of 35-40 m.p.h. were found by means of special mass-speed checks by test cars and tag checks. Here there were no signals, but grade-separations. But on north Michigan Ave. and Sheridan Road, while the traffic remained very dense, synchronized signals (uncoordinated) reduced the average highway speeds to 15-20 m.p.h. or lower in some congested sections. It is this situation that the north Outer Drive will remedy as it has on the south side.

A ten-lane dual drive

This new Outer Drive crosses the Chicago River at its mouth by means of an eight-lane bascule bridge continuing north ten lanes, skirting the shore line to the far north, where "four-leaf clover" grade-separations are being built on filled land. A complete development will make possible a through run of 18 miles across the city, entirely avoiding the central district congestion and requiring little over 30 min., as compared with 66 min. on the best inside city route, an advantage that results from the absence of frequent signal or police controls on the Outer Drive, designed for non-stop movement. Incidentally the inside route—Broadway, LaSalle (widened), Cottage Grove—actually required 119 stops, or 21-35 min., out of 66 min. total time.



Comparative traffic features of proposed Lake Front Drive, Chicago, with eight free lanes (left) and Michigan Ave. with four free lanes (right).

An analysis of these speed checks shows what transit engineers have long known, that frequent stops make it impossible to produce high speeds. Fast routes are always most sensitive to delays. The count showed that one stop per mile reduced normal free-running speeds more than one-fourth; two stops by nearly one-half; four stops by more than two-thirds, i.e., from 38 m.p.h. free to 13 m.p.h. actual.

The in-town section of the new Outer Drive offers an excellent case study of the questions raised by contrasting the present and proposed designs. The new drive is laid out with twin roadways 47 ft. wide, five lanes each; but this is not a continuous pavement, for the twin lanes are separated by a series of refuge strips or islands along the center, wide enough to accommodate left-turn cars waiting in the island openings until proceeding, thus avoiding any conflict with the free-moving traffic of all lanes. Cross-traffic here is minor.

The purpose of the refuge islands is not only to avoid obstruction of the free-flowing main traffic, protect left-turn cars, but also as a refuge for pedestrians. Most important, it permits at some future time, when required, the installation of "full-flexible" progressive signals, timed for half-crossings instead of full-crossings, and with the additional flexibility that these signal intervals can be offset or overlapped to meet the needs of traffic or to adjust the signal system to inequalities of block lengths and thus avoid distorting or crimping the full continuous wave band of the highway. This cannot be done without the safety island refuges. With them the cycle and cross-intervals may be cut almost in half to the great advantage of maximum flow and minimum stoppage. Comparative plans are shown of this new Outer Drive design and also the comparative design of the present Michigan Boulevard north of the river.

Left turns cut lanes

Michigan Boulevard has one wide full-paved roadway 80 ft. in width, eight lanes, with small pedestrian safety islands at intersections. The street has to be signaled for full crossings, for there is no refuge possible at the center as in the new Outer Drive design. The cross-signal allotted is 52 sec., requiring 35 per cent of the time or 46 per cent of the main "go" time, during which traffic on the boulevard is stopped 100 per cent. Moreover, with parking and left-turn lanes preëmpted, there are only two through-lanes in each direction, which applies to the majority of the rush-hour periods. While cross-traffic is light, a sufficient number of left turns still are present to destroy the usefulness of the inside lanes. All left turns are made on the main-line red signal.

This runs to the heart of our problem—the present boulevard with only two free lanes in each direction and nearly a minute's stop time as again four free lanes in each direction on the proposed plan, with the possibility of 30 sec. or less stop time due to half-crossing signaling. Michigan Ave. through the central district is similarly operated, with all left turns and cross-traffic on the red interval, requiring police control in addition to the lights to untangle opposing movements.

Leaving aside the question of the inadequate signaling referred to, it is a question in the author's mind as to the comparative efficiency of an 8- 10- or 12-lane full-paved highway on the existing design. It is believed that the introduction of the twin systems, even sacrificing enough of the roadway to build in the wide refuge islands, will in fact prove more efficient with greater capacity, speed, safety and convenience, especially where the highway runs along the margin of a series of minor intersecting streets with little cross-traffic. Where heavy cross-traffic is anticipated, grade-separations or traffic circles should be built, such as are already in progress in Chicago. But it seems an inordinate waste of public funds and equally an unnecessary burden on the cities transport movements to continue putting into effect these less efficient designs and obsolete signal systems.

Rail vs. motor

The broad economic question is even more important; it can only be touched on here. For in a balanced program and budget that will best meet current public needs for coordinated rail and motor transport, the real precedence of one type of investment over the other, in given cases, ought to be determined on the basis of relative cost of each agency per unit of service given, i.e., total cost per passenger-mile, including all fixed, operating and "hidden" overhead charges allocated to the services. In this balance-sheet full consideration should be given to the traffic volume and the necessary peak capacity, speed, safety and convenience. If these great highways, which cost often many times more than railway lines (with only one-third of the passenger capacity), are to achieve their rightful place as real self-supporting "public utilities," they must become subject to the dictates of "public convenience and necessity" in the city budget, at least in the long run, if a stable and rational city development is to eventuate.

Transit need not be imperiled by well-planned, segregated traffic highways that are capable of delivering an entirely different type of service. High-speed traffic remains relatively small in volume, but nevertheless it is needed in everyday business in large cities and will be paid for by those who can afford the highest-cost transportation—by automobile. Transit will always carry the mass of the people at moderate speed and corresponding low cost. No vehicle has yet appeared which can carry the masses at such low cost as the electric car when all costs are properly balanced by the same standards of accounting. It seems to the author that the large question confronting those who desire rational city development is to find a better means of getting more for their money in the design and control of these essential major traffic arteries.

The specific information herein is presented by courtesy of the commissioners of Lincoln Park, Chicago, with the collaboration of Hugh E. Young, consulting engineer of the Chicago Plan Commission (and the commissioners of Lincoln Park), and his staff.

Water-Treatment Costs Analyzed for Savings

PUBLIC DEMAND for pure water on the part of the majority of a community is often opposed by a militant minority on the ground of economy. The added cost of water treatment is often attacked, the operator is put on the defensive and is requested to curtail drastically wherever he can. Chemicals and washwater for instance, to the unknowing must cost a lot of money, so there is pressure to cut them to the bone. As a matter of fact, in any given breakdown of the total expenditures many other points of attack, such as intelligent care in keeping down the peaks in the electric load curve or use of a more efficient pump, may mean several times as much as any saving that an operator may make by reducing coagulant quantities or the amount of washwater used.

In an attempt to get a proper perspective of the cost of the various steps in water supply, from source to tap, George B. Prindle, superintendent of the water department, Highland Park, Ill., in a paper before the recent meeting of the Illinois section, American Water Works Association, broke down the various costs of a plant representing fair average conditions with which Illinois operators have to deal. As a basis of computation of costs, he assumed a modern combined pumping station and filtration plant. Softening was not considered. The plant is assumed to be operated electrically, with both purification and pumping, including high lift, under the control of the operator. Purification consists of coagulation with alum, sedimentation, sterilization with ammonia and chlorine, rapid-sand filtration and odor control with powdered activated carbon. While this description fits the Highland Park plant, it is also typical of many others along the Lake Michigan shore. The following operating figures given are average rather than actual, since a survey was made of a number of plants on the lake.

Assumed heads are 30 ft. for raw water, 40 ft. for washwater and 170 ft. for filtered water, with an overall efficiency of pumping of 70 per cent. Washwater used is taken at 3 per cent. Unit prices are as follows: energy, 15c. per kw.-hr.; alum, $1.25 per cwt.; ammonia, 16.5c. per lb.; and chlorine, 7.5c. per lb. Chemical treatment was assumed to require 1.5 grains per gallon of alum, 1.5 lb. of ammonia per million gallons, 3.0 lb. of chlorine per m.g., and 20 lb. of carbon per m.g. Superintendence and labor was assumed to cost $20 per m.g., although in practice this figure will vary from $10 to $50. The cost of heat, light, supplies and maintenance is set at $2 per m.g. On this basis the cost of 1 m.g. of water pumped into the mains will be as follows, exclusive of fixed capital charges:

	Cost	Per Cent of Whole
Raw-water pumpage, 30 ft. x 6.73c.	$2.02	5.0
Alum, 214 lb. x 1.25 per cwt.	2.68	6.6
Ammonia, 1.5 lb. x 16.5 c.	0.25	0.6
Chlorine, 3.0 lb. x 7.5c.	0.23	0.6
Carbon, 20 lb. x 7.0c.	1.40	3.5
Washwater pumpage, 3% ($6.58 as above plus 40 ft. x 6.73c.	0.28	0.7
High-lift pumpage, 170 ft. x 6.73c	11.44	28.4
Superintendence and labor	20.00	49.6
Heat, light, supplies and maintenance	2.00	5.0
	$40.30	100.0

Thus it is seen that the total variable purification costs are but 12 per cent. The cost of sterilizing chemical is so low that there should be no tendency on the part of the plant operators to make unwise economies in their use. While this is not always true of the cost of coagulant, nothing can be said for imperfect flocculation due to under-dosage, since the whole theory of rapid sand filtration is predicated on chemical coagulation and sedimentation.

Mr. Prindle's statement as to false economy in the use of washwater is decidedly pertinent: "There is but one reason for washing filters—to get them clean. If we do less than this, we are storing up future trouble. Not so long ago we were taught that it was wrong to wash a filter too clean—that a certain amount of sediment should be left in the bed to seed it, as it were. That theory, which was a relic of the old slow-sand-filter days, has been exploded. There is no such thing as a too-clean filter bed. Most operators, if they are able to get long filter runs, pride themselves on the accomplishment. If it has been done without sacrificing the condition of the sand, it deserves praise. On the other hand, if the bed has been left in service until it has accumulated more dirt than will be removed by the wash, the practice is a mistake. In our hypothetical plant the cost of using 3 per cent of washwater was but 0.7 per cent of the total operating charges. Should we double this, we would have added but 28c. per m.g. to the cost of the water pumped into the mains. Money spent in this direction may prevent serious mud-ball trouble."

As to pumping costs, if efficiency varies from 60 to 80 per cent, there is a spread of $4 per m.g. Savings effected by replacing low-efficiency equipment might yield big dividends in public good will if it were used to improve purification. At any rate the whole variable operating cost chargeable to purification is less than $5 per m.g., while filtered water, outside of the large cities, seldom retails for less than $200 per m.g. The conclusion follows that no cutting of purification costs will greatly impress customers when the operator confesses that his savings have reached the "impressive" figure of 1 per cent (or less) of the water bill, especially if another result has been to produce less satisfactory water.

Interest at A.W.W.A. Meeting Centers on Recovery Program

Passage of National Recovery Act during the meeting directs attention to its possibilities in the waterworks field — Technical sessions consider wide range of operating problems

Engineering News-Record Staff Report

SPECIAL significance was given to the 73d annual convention of the American Water Works Association, held in Chicago, June 12 to 16, because of the passage by Congress of the National Industrial Recovery Act while the convention was in session. The effect of the new legislation upon all phases of the waterworks industry was a fertile field of discussion during the meeting. This question more than any other colored all the discussions occurring during the convention week.

A large share of one afternoon session was devoted to the Recovery Act. The subject was opened by Willard T. Chevalier, publishing director of *Engineering News-Record,* with a discussion of the place of public works in the economic scheme. Colonel Chevalier's presentation consisted of a close analysis of the capitalistic system of economics and the place that must be occupied by public investment if the system is to function smoothly. His analysis began with the axiom that employment is the fundamental purpose of an economic system. This employment depends upon a continuous exchange of goods and services, either those produced by private enterprise or by the community at large. The only essential difference between private enterprise and community enterprise is the necessity of profit in the case of the former. Private investment therefore becomes reproductive, where public investment is productive only.

At a time when the system breaks down to the extent of failing to provide employment for 12,000,000 men it becomes necessary to transfer many from the payrolls of private industries to that of the community. There are two varieties of public payrolls, the productive and nonproductive types. In brief, charity payments or doles are purely nonproductive, while payments made in return for services rendered in creating community facilities are productive. Public works in this sense are in the nature of durable goods rather than in the nature of consumable goods and can be properly paid for by the use of credit. If private enterprise cannot now engage in capital expansion because of the surplus production capacity now in existence, the public works section of the new act is designed to provide reemployment by the production of durable community facilities. It is intended that this re-employment will result in a revival of demand for consumable goods and later in the demand for the durable goods used by industry.

New act interpreted

An interpretation of the new legislation and a forecast as to how it would be administered was presented by Malcolm Pirnie, New York. Mr. Pirnie stated that in his judgment the allocation of money is to be decentralized. No obstacles are to be thrown in the way of financing; instead, aid will be rendered actively. For the start of the program, to expedite matters as much as possible, the rule of "first come, first served" will probably be adopted. In the meaning of the act the cost of a project is to include the preliminary and organization costs, the cost of labor and material and other construction overhead, engineering, a 2 per cent federal administration expense and interest during construction. The direct grant of 30 per cent of the cost of labor and materials provided in the bill represents about 25 per cent of the total cost for most types of projects. The remaining 75 per cent of the cost is to be loaned to the community at 3½ per cent interest, with amortization in 25 years. In this way the total yearly cost to the local community will be 6 per cent on 75 per cent of the cost or 4½ per cent of the total cost annually. It is expected that the grant money will be available for use if the city should so elect for paying the fixed charges for the first five years. If proper security for loans cannot be put up, the federal government can enter into a contract and build the works and lease them to the community.

The same terms apply to private waterworks construction except that the direct grant is not accorded. When preliminary work has not been completed and the funds are not available to carry it out, funds from the Public-Works Administration will probably be obtained in anticipation.

The status of possible projects and the amount of engineering required to bring them to fulfillment was briefly described by George W. Fuller, New York. Mr. Fuller reported that there are now 50,000 civil engineers and surveyors unemployed. Among the engineers in industry unemployment is even greater. The waterworks industry is in a favorable position to exert leadership in putting the public-works program into effect, but organization for that purpose is needed. Among the works cited by Mr. Fuller as needing immediate attention were those that have been made evident by recent drought experiences, strengthening systems to provide for maximum demands and improvements in fire-protection facilities.

The point of view of the waterworks manufacturers was expressed by Denis O'Brien, and that of the National Board of Fire Underwriters by H. T. Munn. H. G. Baity, Chapel Hill, N. C., explained the roles that local sections will play in the fostering of the public-works program.

Chicago's water problems

A number of interesting problems in connection with the water-supply system of a large city, some of them peculiar to Chicago, were described by Myron B. Reynolds, city engineer of Chicago. In a system of tunnels and pumping stations as extensive as Chicago's, serious surges frequently occur when pumps stop suddenly. The surge problem has been extensively studied in the Chicago system, and it has been observed that within 65 to 85 seconds after a shutdown the land tunnels are in reverse flow while lake tunnels are flowing normally. The change from the use of steam-driven triple-expansion pumping to steam-turbine-driven centrifugal pumps in Chicago was explained in Mr. Reynolds' paper as being due to the greater economy made possible by the low-investment equipment. By a careful study of the load and pressures in the distribution system it has been found that the pressures maintained in two of the pumping areas at night were considerably higher than required. Appreciable savings have resulted from the shutdown of one of these stations at night, during some seasons, with no bad effect on service.

Several serious accidents have occurred to Chicago's early tunnel system because of the fact that it had been constructed under private property. The most serious accident to a tunnel carrying water occurred in 1930 when a caisson being constructed for the Chicago and Northwestern Railroad was flooded out as workmen approached the point about 7 ft. above the tunnel. It was found that a large hole had been blown out of the brick lining of the tunnel and 14 ft. of clay cover had caved in. By the use of a steel plate curved to fit the inside of the tunnel as a form, a seal was made with quick-hardening cement in small bags.

A study of the consumption rate in various districts in Chicago has given valuable information regarding the consumption characteristics of the various types of industry. Domestic consumers present two peak-hour demands, one at 7 a.m. and the other at 7 p.m.; the Loop district reaches its maximum at noon, steel plants during the middle of the day, railroads use water at a uniform rate, and the stockyards' maximum is at 4 p.m.

Underground leakage in the Chicago distribution system has also been given a great amount of study. How this leakage is located and eliminated was discussed by J. B. Eddy and B. Phillips, of the Chicago water department. In 1916 the practice was begun of locating and stopping leaks wherever streets were about to be paved. Since that time such tests have been made on 1,067 miles of mains, 28.5 per cent of the total mileage in service at the end of 1932. More than 17 m.g.d. of leakage has been measured in those tests. Other tests have uncovered nearly 7 m.g.d. of leakage, so that a total of 24 m.g.d. has been discovered in those sixteen years, 23 m.g. of which was stopped. More than half of the mileage tested was found tight on the first test. The method used is to isolate a two-block section of the main by closing off all service pipes at the curb and closing the gate valves at the ends of the section. The leakage, if any, is measured into the section through a water meter tapped into the main, bypassing one of the valves. A special rehabilitation party working since 1931 has measured 27 m.g.d. of leakage and stopped nearly 23.5 m.g.d. in 226 miles of pipe. Listening with an aquaphone upon rods in contact with the main is used with great success. Where the mains are at great depth and where the leaks are waterbound a testing method is used that involves the use of dye.

For a number of years the Chicago water department has maintained a number of automatic continuous pressure recorders distributed throughout a distribution system. The value derived from these recorders was described by J. M. Eddy, engineer of water-pipe extension. By studying the information made available by these pressure records it has been possible to readjust station pressures at night, thereby saving considerable in pumping cost.

Pipe coatings

A comprehensive study of bituminous-pipe coating was presented by William M. Wallace and James A. Parks, of the Detroit department of water supply. As a result of their studies the authors recommended a series of physical and chemical tests for determining the suitability of bituminous coatings. The tests recommended include observations of luster, consistency, pliability, specific gravity, flowability when warm, brittleness when cold, resistance to acid or alkali conditions, resistance to the action of water, taste-producing characteristics, volatile matter, softening point, flash and fire points, solubility in carbon bisulphide, ash, and distillation fractions. The coatings considered include asphalt-base and coal-tar base enamel and paint.

Alleviating low pressure

The means adopted by Milwaukee, Wis., to alleviate low-pressure conditions during periods of peak water consumption in the outlying sections, consisting of storage at ground level together with a booster station, were described by Herbert H. Brown, of the Milwaukee water department. The plan consists essentially of installing a large reservoir and pumping capacity at one point in the outlying section of the high-service district near the center of consumption. Ultimately two 6-m.g. ground-level storage tanks will be built with a booster station containing four 30-m.g.d. motor-driven centrifugal pumps. The entire project will cost about $450,000. One 6-m.g. tank was constructed in the fall of 1932, and the booster station is now under construction. The tank will be filled during the night by the pressure of the street mains. Water will be pumped out of the tank the following afternoon during the sprinkling peak and discharged into the distribution system at the same pressure maintained at the pumping station.

Low-heat cement

An account of the work done at Pasadena, Calif., to develop specifications for a cement that would develop only a small amount of heat in setting, to be used in connection with the construction of the Pine Canyon Dam, was presented by Samuel B. Morris, Pasadena, Calif., in a paper entitled "Special Low-Heat Cement for Mass-Concrete Dam."

Problems involved in providing water service to private sprinkler systems and standpipes were given attention in a paper by J. A. Jensen, Minneapolis, Minn. Mr. Jensen stated that in his city a sprinkler system is regarded as a special privilege, and although no charge is made for actual water used the owner of the sprinkler system is charged for readiness to serve. He maintained that the fire-supply connection and the regular service should be separate, with a valve on the fire service. The system of regulation and inspection of private fire systems in St. Louis, New York, Charleston, South Carolina, and St. Paul, Minn., were described by a subsequent speaker and compared with the system used by Minneapolis.

Electrolysis

The effect of electrolysis on water-service lines and on the water itself, as a result of the promiscuous grounding of electric lines, was discussed by Nicholas S. Hill, Jr., of New York City. The Hackensack Water Co. recently has made a number of observations of meter bottoms and service pipes being destroyed by the action of stray electric current. It was observed that electric currents of very small magnitude are sufficient to cause considerable damage. One of the methods being considered to combat this condition is the use of an insulating enamel on the meters and pipes. In the discussion it was brought out that where house plumbing consists of brass piping, a small amount of electricity carried by the pipes will be sufficient to dissolve copper into the water and impart a greenish color to it.

Cement-lined mains

One entire session was devoted to cement-lined water mains. T. H. Wiggin, J. E. Gibson, R. J. Newson, D. B. Stokes, H. Y. Carson, Wm. W. Brush and F. E. Hale among others contributed valuable discussion on cutting, tapping and handling methods and separation and cracking and solubility of lining. Fault-finding was confined largely to details. Cement lining, according to the discussion, is a success and in most cases an economic necessity.

In Charleston a badly tuberculated cast-iron pipe showed a Hazen and Williams coefficient of 74; after cleaning the pipe the coefficient rose to 104, but 30 days later it was back to 85. In contrast, a cement-lined pipe showed a coefficient of 135 when new, 128 a year later and 145 seven and one-half years later, although better test conditions with a steady flow obtaining in the latter test. This year the coefficient was 138. From other parts of the country coefficients as high as 180 were reported.

The principal purpose of cement-lining being to combat corrosive waters, this phase of the subject was discussed extensively. Solubility of the lining in water has resulted in meter stoppages, but this has usually occurred with soft waters. Also, the greatest amount of the lining goes into solution within 30 hours after the line is put in service, and thereafter the increase in alkalinity is very gradual. Hard waters are much less active so far as the lining is concerned. When solubility is a problem the pipe may be tar-dipped or sprayed with asphalt. Mr. Brush and Dr. Hale, of New York, reported the asphalt spray to be the most beneficial; heat from the tar dip loosened the lining. A thin coating that is barely visible has proved efficient. Cold asphalt inner linings about 1/64 in. thick are used in New York.

Consumer relations

An afternoon session was devoted to a discussion in consumer relations, especially as they have been affected by the depression. The discussion was opened by Frank C. Jordan, of the Indianapolis Water Co., who spoke on consumers' good will and its value. During the course of the depression the company which the speaker represented has had occasion to develop a favorable public opinion by its sympathetic attitude toward consumers who have been financially unable to pay their water bills.

The reverse side of the consumer-relation subject, consumers' complaints, was discussed by Eugene F. Dugger, Newport News, Va. Three general types of complaints were described by the speaker: complaints of incorrect meter readings, complaints of inadequate pressure and complaints against a stand-by or service charge. In the case of an alleged overcharge, the customer is given an opportunity to be present at a shop test of the meter.

A paper by M. F. Hoffman, of Cincinnati, Ohio, was presented to the meeting which outlined the policies employed in that city in regard to delinquent water bills. Cincinnati's accounting methods allow great flexibility in the handling of delinquent accounts. By a careful follow-up policy, the department has been able to keep delinquency down to about ½ of 1 per cent of water sales. It was brought out in the following discussion that Harvey, Ill., has about 45 per cent of the number of its accounts delinquent, and Detroit, Mich., in the neighborhood of 25 per cent.

Other subjects discussed at this session were the use of a battery of several small meters instead of a single large one, and the measurement of small flows. Four points were registered in favor of the battery of small meters: the expense of handling and repair is less per unit, repair and maintenance is less difficult, water can be temporarily supplied through the remaining meters when one is out of repair, and the necessity of estimating total flow during a period of meter repair is eliminated.

Water purification

At the opening of the sessions of the water-purification division a group of papers was presented directly concerned with the advances being made in the laboratory work. The first of this group was a paper presented by John F. Norton, Kalamazoo, Mich., on "Current Research in Water Bacteriology." Dr. Norton's paper was an attempt to evaluate the more important publications that have appeared in the past few years, particularly those dealing with the detection of the coli-aerogenes group in raw and finished water supplies. Practically all of the research work done recently has been for the purpose of increasing the accuracy of bacterial examinations, particularly to cultivate the pure fecal organisms and to inhibit those of non-fecal origin. A number of inhibiting agents have been devised for this work, including bile and various dyes. A representative of the new type of medium developed in recent years is the so-called Dominick-Lauter medium. It contains methylene blue, erythroscene and brom cresol purple, and is representative of a group of new media containing mixtures of dyes. According to Dr. Norton, direct-plating methods whereby the colonies resulting from non-fecal organisms can be distinguished from the others have not yet proved practicable. In discussions, N. J. Howard, Toronto, Ont., remarked that there are three types of bile salts on the market and the results reported from any of the bile medium tests must be considered in the light of the type of salt employed.

M. M. Braidech, Cleveland, Ohio, chairman of the committee on testing water-purification chemicals presented a tentative draft of the committee's report. The members of the committee have been engaged for some months in preparing specifications that would be particularly adapted to waterworks requirements. Specifications for all of the commonly used chemicals are to be included, comprising 27 in all. The present report covers 19.

An exhaustive paper on testing of zeolites was presented by H. L. Tiger, of New York. Apparatus and test methods were described for the determination of chemicals and physical characteristics of zeolite to facilitate study of their use in water-softening work.

Chicago lake pollution

To meet the lake-pollution situation, Chicago is preparing to change the method of treating the water for the south side from chlorination at the three pumping stations to the use of ammonia and chlorine at the two intake cribs. The proposed plan was described in a paper presented by H. H. Gerstein.

Tastes and odors

During the past year the committee on control of taste and odors in public water supplies has had three main activities. It has canvassed the taste-and-odor-control experiences in a number of representative states. It has attempted to obtain cooperative studies of the methods of odor determination that have been proposed to supplant the methods now given in "Standard Methods." It has further attempted to obtain cooperative critical study of present and proposed methods of phenol determination in water supply. The report of the committee as presented to the water-purification division reviewed in some detail the results of these three activities.

In regard to the present status of the control of tastes and odors the committee's report summarizes the experiences in twelve states where reasonably complete data have been furnished. Prechlorination has been found a great aid to odor control, particularly in New York State. To the west and south of New York, however, it is used very little. There has been a large increase in the number of plants using the ammonia-chlorine process. The committee reports that this appears to be due not so much to the success of this process in preventing or eliminating tastes and odors as in the better appreciation by the operator of the peculiar advantages. There is particular benefit in the maintenance of high residual values throughout the distribution system. Many operators report that ammonia-chlorine process is of assistance in preventing certain tastes and odors if applied before such tastes are formed. Application after their formation sometimes intensifies the trouble. Powdered activated carbon, either alone or in conjunction with other methods used, in the minds of many operators, is the most universally applicable taste-and-odor-control measure now available. Very few operators report it as being unsuccessful in removing any taste or odor encountered. It appears to be used almost to the exclusion of other methods in the Southeastern, Southern and Middle Western states. Granular activated carbon is being used to a limited extent, several news plants having been installed on municipal supplies. The use of bleaching clays and similar material has not shown any decided growth. The use of potassium permanganate, super and dechlorination for hydrogen sulphide removal and the use of ozone are not at the present time in sufficient installations to warrant their consideration as general control measures. The committee further remarked that the success of some of the newer control methods included should not obscure the adequacy of aeration and copper treatment of reservoirs in many cases.

The committee reported that the so-called "Spaulding Threshold Method" of odor examination offers considerable merit and deserves more study and more general application in the water laboratories.

Lime sludge disposal

The methods adopted for the disposal of the large quantities of lime sludge at the new water-softening and purification plant for the Mahoning Valley Sanitary District were described in a paper by W. H. Dittoe, Youngstown, Ohio. Two large ponds have been created to receive the sludge as pumped from the sedimentation basin. As the solid material settles to the bottom, the supernatant liquor overflows and the lime sludge is allowed to dry in air. The method of operation adopted is to utilize one pond until it is completely full, then allow the sludge to dry while using the other pond.

One pond has a capacity of 550,000 cu.ft.; the other a capacity of 445,000 cu.ft. A 4-in. sludge line discharges into either pond. The cost of installation was $9,500.

The use of contact beds of limestone for the removal of aggressive carbon dioxide from water was described by Charles R. Cox, Albany, N. Y. The work described by Mr. Cox was in connection with four test installations in New York State. The test installation at Albany consisted of an upward flow bed 3 in. in diameter and 24 in. high, containing limestone graded between ¼ and ¾ in. in size. At the Sherrill-Kenwood plant the test bed had an area of ⅔ sq.ft. and varied from 30 to 36 in. in depth. At the Brooklyn State Hospital a highly corrosive water had its carbon dioxide content reduced from 26 to 3 p.p.m. by 30 min. of contact with 300 cu.yd. of crushed marble. The contact increased the pH from about 6 to 8. The total cost of this installation was $6,000.

Following the report of the committee on filtering materials, which briefly outlined the research work done by the various experimenters during the past year, Prof. Gordon M. Fair, Harvard University, discussed the fundamental factors governing the streamline flow of water through sand. The discussion as presented by Professor Fair applied the same fundamental principles to filtration and to expansion.

Cost of hard water

An economic study of the soap waste occasioned by the use of hard water was presented by H. W. Hudson, of Butler University, Indianapolis, Ind. To obtain information concerning the problem, market surveys of retail soap sales were made in Chicago Heights, Bloomington and Champaign-Urbana, Ill., and Superior, Wis. These cities were chosen for their different types of water supply. They are comparable in size and large enough for the results to be significant. The waters supplied range in hardness from 40 p.p.m. at Superior to 555 at Chicago Heights. Using the soap consumption in Superior as a norm, the wastage per capita in each of the other cities was computed. The estimate of the cost of softening the water in the other cities revealed that in every case the cost of a municipal softening plant would be more than paid for by the saving in soap cost alone. The use of cisterns or household water softeners would not yield quite so favorable a comparison.

Progress in purification

In a paper entitled "Progress in Water Purification," George W. Fuller, New York, gave a brief and interesting history of water purification. Mr. Fuller divided into four periods the time that has elapsed since the Kirkwood report to the city of St. Louis in 1869. The first period, from 1869 to 1886, which can be designated as that of the beginnings of the art, saw the beginnings of bacteriology, the construction of the first two slow sand filters at Poughkeepsie, N. Y., and Hudson, N. Y., and the beginnings of rapid sand filtration at Somerville, N. J., and in a number of paper mills. The second period, characterized by intensive research and development, was from 1887 to 1902. It was during this period that the Massachusetts state board of health was reorganized and the Lawrence experiment station was started. The cholera epidemics at Berlin and Hamburg-Altona gave ample proof of the value of water purification, but there was a great deal of uncertainty as to the most effective method to employ. There were series of thorough-going experiments during this period, including those at Providence, Louisville and Cincinnati. Basic patents on water-purification processes expired at about the end of this period.

The third period was one of rapid accomplishment and application of the knowledge that had been gained during the previous year. Rapid sand filters, slow sand filters and double filtration plants were built. Proprietary guarantees were viewed with increasing disfavor, and purification plants built to an engineer's design became more common. Chlorination came into use at about the beginning of this period. The harmlessness of alum was recognized. Water softening became of greater importance. Corrosion of metals began to be studied seriously, and hydrogen-iron concentration was developed.

The fourth period, which extends from 1918 to the present time, can be designated as one of refinement in operation and design. One of the outstanding characteristics of present-day practice is the far better preliminary treatment given before filtration. In the design and operation of filter plants themselves, mechanical appliances are being developed rapidly for removal of sludge from settling basins and for flocculation. Preliminary clarification and preliminary chlorination are being adopted, operation is being modified to avoid objectionable tastes and odors, corrosive qualities of the water are being corrected, aeration is used to a greater extent, and the softening process has become much more effective.

At the present time 31,000,000 people use 38 m.g.d. of filtered water in the United States.

Industrial Recovery Act Passed by Congress

Public-works section is changed slightly from that of the original bill—Total remains at $3,300,000,000, with highways scheduled to receive $400,000,000, forest and park roads $50,000,000, and "subsistence homesteads" $25,000,000

THE National Industrial Recovery Act was passed by the Senate late Monday night, June 12, in the form approved by the House, and was signed by the President on June 16.

In its major provisions it does not depart radically from the form of the bill as submitted to Congress by the President, except that sections providing for taxes to support the act and sections providing for the regulation of the oil industry have been added. Important detail changes in the public-works sections include changes in the method of allocating highway money among the states, the addition of specific stipulations as to the amounts to be expended on forest and park roads and roads through Indian lands, $50,000,000, and a provision of $25,000,000 for "subsistence homesteads."

In the following the text of Title II—Public Works—is given in full together with those sections of Title I—Industrial Recovery—that are of special interest to readers of this journal.

An Act (H. R. 5755) to encourage national industrial recovery, to foster fair competition, and to provide for the construction of certain useful public works, and for other purposes.

Be in enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

Title I—Industrial Recovery:

Sec. 1. A national emergency productive of widespread unemployment and disorganization of industry, which burdens interstate and foreign commerce, affects the public welfare, and undermines the standards of living of the American people, is hereby declared to exist. It is hereby declared to be the policy of Congress to remove obstructions to the free flow of interstate and foreign commerce which tend to diminish the amount thereof; and to provide for the general welfare by promoting the organization of industry for the purpose of cooperative action among trade groups, to induce and maintain united action of labor and management under adequate governmental sanction and supervision, to eliminate unfair competitive practices, to promote the fullest possible utilization of the present productive capacity of industries, to avoid undue restriction of production (except as may be temporarily required), to increase the consumption of industrial and agricultural products by increasing purchasing power, to reduce and relieve unemployment, to improve standards of labor, and otherwise to rehabilitate industry and to conserve natural resources.

Sec. 2 (a) To effectuate the policy of this title, the President is hereby authorized to establish such agencies, to accept and utilize such voluntary and uncompensated services, to appoint, without regard to the provisions of the civil service laws, such officers and employes, and to utilize such federal officers and employes, and, with the consent of the state, such state and local officers and employes, as he may find necessary, to prescribe their authorities, duties, responsibilities, and tenure, and, without regard to the Classification Act of 1923, as amended, to fix the compensation of any officers and employes so appointed.

(b) The President may delegate any of his functions and powers under this title to such officers, agents, and employes as he may designate or appoint, and may establish an industrial planning and research agency to aid in carrying out his functions under this title.

(c) This title shall cease to be in effect and any agencies established hereunder shall cease to exist at the expiration of two years after the date of enactment of this act, or sooner if the President shall by proclamation or the Congress shall by joint resolution declare that the emergency recognized by section 1 has ended.

Codes of fair competition

Sec. 3 (a) Upon the application to the President by one or more trade or industrial associations or groups, the President may approve a code or codes of fair competition for the trade or industry or subdivision thereof, represented by the applicant or applicants, if the President finds

(1) That such associations or groups impose no inequitable restrictions on admission to membership therein and are truly representative of such trades or industries or subdivisions thereof, and

(2) That such code or codes are not designed to promote monopolies or to eliminate or oppress small enterprises and will not operate to discriminate against them, and will tend to effectuate the policy of this title:

Provided, that such code or codes shall not permit monopolies or monopolistic practices.

* * *

(d) Upon his own motion, or if complaint is made to the President that abuses inimical to the public interest and contrary to the policy herein declared are prevalent in any trade or industry or subdivision thereof, and if no code of fair competition therefor has theretofore been approved by the President, the President, after such public notice and hearing as he shall specify, may prescribe and approve a code of fair competition for such trade or industry or subdivision thereof, which shall have the same effect as a code of fair competition approved by the President.

(e) On his own motion, or if any labor organization, or any trade or industrial organization, association, or group, which has complied with the provisions of this title, shall make complaint to the President that any article or articles are being imported into the United States in substantial quantities or increasing ratio to domestic production of any competitive article or articles and on such terms or under such conditions as to render ineffective or seriously to endanger the maintenance of any code or agreement under this title, the President may cause an immediate investigation to be made by the United States Tariff Commission, and if the President shall find the existence of such facts, he shall direct that the article or articles concerned shall be permitted entry into the United States only upon such terms and conditions and subject to the payment of such fees and to such limitations in the total quantity which may be imported as he shall find it necessary to prescribe in order that the entry thereof shall not render or tend to render ineffective any code or agreement made under this title.

Sec. 4. (a) The President is authorized to enter into agreements with, and to approve voluntary agreements between and among, persons engaged in a trade or industry, labor organizations, and trade or industrial organizations, associations, or groups, relating to any trade or industry, if in his judgment such agreements will aid in effectuating the policy of this title with respect to transactions in or affecting interstate or foreign commerce, and will be consistent with the requirements of clause (2) of subsection (a) of section 3 for a code of fair competition.

Licensing

(b) Whenever the President shall find that destructive wage or price cutting or other activities contrary to the policy of this title are being practiced in any trade or industry or any subdivision thereof, and after such public notice and hearing as he shall specify, shall find it essential to license business enterprises in order to make effective a code of fair competition or an agreement under this title or otherwise to effectuate the policy of this title, and shall publicly so announce, no person shall, after a date fixed in such announcement, engage in or carry on any business, in or affecting interstate or foreign commerce, specified in such announcement, unless he shall have first obtained a license issued pursuant to such regulations as the President shall prescribe.

The President may suspend or revoke any such license, after due notice.

Sec. 5. While this title is in effect (or in the case of a license, while section 4 (a) is in effect) and for sixty days thereafter, any code, agreement, or license approved, prescribed, or issued and in effect under this title, and any action complying with the provisions thereof taken during such period, shall be exempt from the provisions of the anti-trust laws of the United States.

* * *

Sec. 6. (a) No trade or industrial association or group shall be eligible to receive the benefit of the provisions of this title until it files with the President a statement containing such information relating to the activities of the association or group as the President shall by regulation prescribe.

(b) The President is authorized to prescribe rules and regulations designed to insure that any organization availing itself of the benefits of this title shall be truly representative of the trade or industry or subdivision thereof represented by such organization. Any organization violating any such rule or regulation shall cease to be entitled to the benefits of this title.

Sec. 7. (a) Every code of fair competition, agreement, and license approved, prescribed, or issued under this title shall contain the following conditions:

(1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection;

(2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and

(3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

[The remainder of this section relates to conditions of labor, agreements as to hours of labor, etc. Sections 7 and 8 relate to the Agricultural Adjustment Act and to oil regulation.—EDITOR.]

Title II—Public works and construction projects

Sec. 201. (a) To effectuate the purposes of this title, the President is hereby authorized to create a Federal Emergency Administration of Public Works, all the powers of which shall be exercised by a Federal Emergency Administrator of Public Works (hereafter referred to as the "Administrator"), and to establish such agencies, to accept and utilize such voluntary and uncompensated services, to appoint without regard to the civil service laws, such officers and employees, and to utilize such federal officers and employees, and, with the consent of the state, such state and local officers and employees as he may find necessary; to prescribe their authorities, duties, responsibilities, and tenure, and, without regard to the Classification Act of 1923, as amended, to fix the compensation of any officers and employees so appointed. The President may delegate any of his functions and powers under this title to such officers, agents, and employes as he may designate or appoint.

(b) The Administrator may, without regard to the civil service laws or the Classification Act of 1923, as amended, appoint and fix the compensation of such experts and such other officers and employees as are necessary to carry out the provisions of this title; and may make such expenditures (including expenditures for personal services and rent at the seat of government and elsewhere, for law books and books of reference, and for paper, printing, and binding) as are necessary to carry out the provisions of this title.

(c) All such compensation, expenses, and allowances shall be paid out of funds made available by this Act.

(d) After the expiration of two years after the date of the enactment of this Act, or sooner if the President shall by proclamation or the Congress shall by joint resolution declare that the emergency recognized by section 1 has ended the President shall not make any further loans or grants or enter upon any new construction under this title, and any agencies established hereunder shall cease to exist and any of their remaining functions shall be transferred to such departments of the government as the President shall designate:

Provided, that he may issue funds to a borrower under this title prior to Jan. 23, 1939, under the terms of any agreement, or any commitment to bid upon or purchase bonds, entered into with such borrower prior to the date of termination, under this section, of the power of the President to make loans.

Sec. 202. The Administrator under the

direction of the President, shall prepare a comprehensive program of public works, which shall include among other things the following:

(a) Construction, repair, and improvement of public highways and park ways, public buildings, and any publicly owned instrumentalities and facilities;

(b) Conservation and development of natural resources, including control, utilization, and purification of waters, prevention of soil or coastal erosion, development of water power, transmission of electrical energy, and construction of river and harbor improvements and flood control, and also the construction of any river or drainage improvement required to perform or satisfy any obligation incurred by the United States through a treaty with a foreign government heretofore ratified and to restore or develop for the use of any state or its citizens water taken from or denied to them by performance on the part of the United States of treaty obligations heretofore assumed: *Provided*, That no river or harbor improvements shall be carried out unless they shall have heretofore or hereafter been adopted by the Congress or are recommended by the Chief of Engineers of the United States Army;

(c) Any projects of the character heretofore constructed or carried on either directly by public authority or with public aid to serve the interests of the general public;

(d) Construction, reconstruction, alteration, or repair under public regulation or control of low-cost housing and slum-clearance projects;

(e) Any project (other than those included in the foregoing classes) of any character heretofore eligible for loans under subsection (a) of section 201 of the Emergency Relief and Construction Act of 1932, as amended, and paragraph (3) of such subsection (a) shall for such purposes be held to include loans for the construction or completion of hospitals the operation of which is partly financed from public funds, and of reservoirs and pumping plants and for the construction of dry docks; and if in the opinion of the President it seems desirable, the construction of naval vessels within the terms and/or limits established by the London Naval Treaty of 1930 and of aircraft required therefore, and construction of heavier-than-air aircraft and technical construction for the Army Air Corps and such Army housing projects as the President may approve, and provision of original equipment for the mechanization or motorization of such Army tactical units as he may designate;

Provided, however, that in the event of an international agreement for the further limitation of armament, to which the United States is signatory, the President is hereby authorized and empowered to suspend, in whole or in part, any such naval or military construction or mechanization and motorization of Army units;

Provided, further, that this title shall not be applicable to public works under the jurisdiction or control of the Architect of the Capitol or of any commission or committee for which such architect is the contracting and/or executive officer.

Sec. 203 (a) With a view to increasing employment quickly (while reasonably securing any loans made by the United States), the President is authorized and empowered, through the administrator or through such other agencies as he may designate or create,

(1) to construct, finance, or aid in the construction or financing of any public-works project included in the program prepared pursuant to section 202;

(2) upon such terms as the President shall prescribe, to make grants to states, municipalities, or other public bodies for the construction, repair, or improvement of any such project, but no such grant shall be in excess of 30 per centum of the cost of the labor and materials employed upon such project;

(3) to acquire by purchase, or by exercise of the power of eminent domain, any real or personal property in connection with the construction of any such project, and to sell any security acquired or any property so constructed or acquired or to lease any such property with or without the privilege of purchase.

Provided, That all moneys received from any such sale or lease or the repayment of any loan shall be used to retire obligations issued pursuant to section 209 of this act, in addition to any other moneys required to be used for such purpose;

(4) to aid in the financing of such railroad maintenance and equipment as may be approved by the Interstate Commerce Commission as desirable for the improvement of transportation facilities; and

(5) to advance, upon request of the Commission having jurisdiction of the project, the unappropriated balance of the sum authorized for carrying out the provisions of the act entitled "An Act to provide for the construction and equipment of an annex to the Library of Congress," approved June 13, 1930 (46 Stat. 583); such advance to be expended under the direction of such Commission and in accordance with such act:

Provided, That in deciding to extend any aid or grant hereunder to any State, county, or municipality the President may consider whether action is in process or in good faith assured therein reasonably designed to bring the ordinary current expenditures thereof within the prudently estimated revenues thereof. The provisions of this section and section 202 shall extend to public works in the several States, Hawaii, Alaska, the District of Columbia, Puerto Rico, the Canal Zone, and the Virgin Islands.

(b) All expenditure for authorized travel by officers and employees, including subsistence, required on account of any Federal public-works projects, shall be charged to the amounts allocated to such projects, notwithstanding any other provisions of law; and there is authorized to be employed such personal services in the District of Columbia and elsewhere as may be required to be engaged upon such work and to be in addition to employees otherwise provided for, the compensation of such additional personal services to be a charge against the funds made available for such construction work.

(c) In the acquisition of any land or site for the purpose of Federal public buildings and in the construction of such buildings provided for in this title, the provisions contained in sections 305 and 306 of the Emergency Relief and Construction Act of 1932, as amended, shall apply.

(d) The President, in his discretion, and under such terms as he may prescribe, may extend any of the benefits of this title to any State, county, or municipality notwithstanding any constitutional or legal restriction or limitation on the right or power of such state, county, or municipality to borrow money or incur indebtedness.

Funds for highway work

Sec. 204 (a) For the purpose of providing for emergency construction of public highways and related projects, the President is authorized to make grants to the highway departments of the several states in an amount not less than $400,000,000, to be expended by such departments in accordance with the provisions of the Federal Highway Act, approved Nov. 9, 1921, as amended and supplemented, except as provided in this title, as follows:

(1) For expenditure in emergency construction on the federal-aid highways system and extensions thereof into and through municipalities. The amount apportioned to any state under this paragraph may be used to pay all or any part of the cost of surveys, plans, and of highway and bridge construction, including the elimination of hazards to highway traffic, such as the separation of grades at crossing, the reconstruction of existing railroad grade crossing structures, the relocation of highways to eliminate railroad crossings, the widening of narrow bridges and roadways, the building of footpaths, the replacement of unsafe bridges, the construction of routes to avoid congested areas, the construction of facilities to improve accessibility and the free flow of traffic, and the cost of any other construction that will provide safer traffic facilities or definitely eliminate existing hazards to pedestrian or vehicular traffic. No funds made available by this title shall be used for the acquisition of any land, right of way, or easement in connection with any railroad grade elimination project.

(2) For expenditure in emergency construction on secondary or feeder roads to be agreed upon by the state highway departments and the Secretary of Agriculture: *Provided*, That the state or responsible political subdivision shall provide for the proper maintenance of said roads. Such grants shall be available for payment of the full cost of surveys, plans, improvement, and construction of secondary or feeder roads, on which projects shall be submitted by the state highway department and approved by the Secretary of Agriculture.

(b) Any amounts allocated by the President for grants under subsection (a) of this section shall be apportioned among the several states, seven-eighths in accordance with the provisions of section 21 of the Federal Highway Act, approved Nov. 9, 1921, as amended and supplemented (which Act is hereby further amended for the purposes of this title to include the District of Columbia), and one-eighth in the ratio which the population of each state bears to the total population of the United States, according to the latest decennial census, and shall be available on July 1, 1933, and shall remain available until expended; but no part of the funds apportioned to any state need be matched by the state, and such funds may also be used in lieu of state funds to match unobligated balances of previous apportionments of regular federal-aid appropriations.

(c) All contracts involving the expenditure of such grants shall contain provisions establishing minimum rates of wages; to be predetermined by the state highway department, which contractors shall pay to skilled and unskilled labor, and such minimum rates shall be stated in the invitation for bids and shall be included in proposals for bids for the work.

(d) In the expenditure of such amounts, the limitations in the Federal Highway Act, approved Nov. 9, 1921, as amended and supplemented, upon highway construction, reconstruction, and bridges within municipalities and upon payments per mile which may be made from Federal funds, shall not apply.

(e) As used in this section the term "state" includes the Territory of Hawaii and the District of Columbia. The term "highway" as defined in the Federal Highway Act approved Nov. 9, 1921, as amended and supplemented, for the purposes of this section, shall be deemed to include such main parkways as may be designated by the state and approved by the Secretary of Agriculture as part of the federal-aid highway system.

(f) Whenever, in connection with the construction of any highway project under this section or section 202 of this act, it is necessary to acquire rights of way over or through any property or tracts of land owned and controlled by the government of the United States, it shall be the duty of the proper official of the government of the United States having control of such property or tracts of land with the approval of the President and the Attorney General of the United States, and without any expense whatsoever to the United States, to perform any acts and to execute any agreements necessary to grant the rights of way so required, but if at any time the land or the property the subject of the agreement shall cease to be used for the purposes of the highway, the title in and the jurisdiction over the land or property shall automatically revert to the government of the United States and the agreement shall so provide.

(g) Hereafter in the administration of the Federal Highway Act, and Acts amendatory thereof or supplementary thereto, the first paragraph of section 9 of said Act shall not apply to publicly owned toll bridges or approaches thereto, operated by the highway department of any state, subject, however, to the condition that all tolls received from the operation of any such bridge, less the actual cost of operation and maintenance, shall be applied to the repayment of the cost of its construction or acquisition, and when the cost of its construction or acquisition shall have been repaid in full, such bridge thereafter shall be maintained and operated as a free bridge.

Forest and park roads

Sec. 205. (a) Not less than $50,000,000 of the amount made available by this Act shall be allotted for (A) national forest highways, (B) national forest roads, trails, bridges, and related projects, (C) national park roads and trails in national parks owned or authorized, (D) roads on Indian reservations, and (E) roads through public lands, to be expended in the same manner as provided in paragraph (2) of section 301 of the Emergency Relief and Construction Act of 1932, in the case of appropriations allocated for such purposes, respectively, in such section 301, to remain available until expended.

(b) The President may also allot funds made available by this Act for the construction, repair, and improvement of public highways in Alaska, the Canal Zone, Puerto Rico, and the Virgin Islands.

Wages and hours of labor

Sec. 206. (a) All contracts let for construction projects and all loans and grants pursuant to this title shall contain such provisions as are necessary to insure (1) that no convict labor shall be employed on any such project; (2) that (except in executive, administrative, and supervisory positions), so far as practicable and feasible, no individual directly employed on any such project shall be permitted to work more than 30 hours in any one week; (3) that all employees shall be paid just and reasonable wages which shall be compensation sufficient to provide, for the hours of labor as limited, a standard of living in decency and comfort; (4) that in the employment of labor in connection with any such project, preference shall be given, where they are qualified, to ex-service men with dependents and then in the following order:

(A) To citizens of the United States and aliens who have declared their intention of becoming citizens, who are bona fide residents of the political subdivision and/or county in which the work is to be performed, and

(B) To citizens of the United States and aliens who have declared their intention of becoming citizens who are bona fide residents of the state, territory, or district in which the work is to be performed: *Provided,* That these preferences shall apply only where such labor is available and qualified to perform the work to which the employment relates; and (5) that the maximum of human labor shall be used in lieu of machinery wherever practicable and consistent with sound economy and public advantage.

Sec. 207. (a) For the purpose of expediting the actual construction of public works contemplated by this title and to provide a means of financial assistance to persons under contract with the United States to perform such construction, the President is authorized and empowered, through the Administrator or through such other agencies as he may designate or create, to approve any assignment executed by any such contractor, with the written consent of the surety or sureties upon the penal bond executed in connection with his contract, to any national or State bank, or his claim against the United States, or any part of such claim, under such contract; and any assignment so approved shall be valid for all purposes, notwithstanding the provisions of sections 3737 and 3477 of the Revised Statutes, as amended.

(b) The funds received by a contractor under any advances made in consideration of any such assignment are hereby declared to be trust funds in the hands of such contractor to be first applied to the payment of claims of subcontractors, architects, engineers, surveyors, laborers, and material men in connection with the project, to the payment of premiums on the penal bond or bonds, and premiums accruing during the construction of such project on insurance policies taken in connection therewith. Any contractor and any officer, director, or agent of any such contractor, who applies, or consents to the application of, such funds for any other purpose and fails to pay any claim or premium hereinbefore mentioned, shall be deemed guilty of a misdemeanor and shall be punished by a fine of not more than $1,000 or by imprisonment for not more than one year, or by both.

(c) Nothing in this section shall be considered as imposing upon the assignee any obligation to see to the proper application of the funds advanced by the assignee in consideration of such assignment.

Subsistence homesteads

Sec. 208. To provide for aiding the redistribution of the overbalance of population in industrial centers $25,000,000 is hereby made available to the President, to be used by him through such agencies as he may establish and under such regulations as he may make, for making loans for and otherwise aiding in the purchase of subsistence homesteads. The moneys collected as repayment of said loans shall constitute a revolving fund to be administered as directed by the President for the purposes of this section.

Sec. 209. The President is authorized to prescribe such rules and regulations as may be necessary to carry out the purposes of this title, and any violation of any such rule or regulation shall be punishable by fine of not to exceed $500 or imprisonment not to exceed six months, or both.

[Section 210 relates to the issue of securities by the Secretary of the Treasury to finance the operation of the Act, and sections 211 to 219 set up tax provisions to support it.—EDITOR.]

Appropriation

Sec. 220. For the purposes of this Act, there is hereby authorized to be appropriated out of any money in the Treasury not otherwise appropriated, the sum of $3,300,000,000.

Title III—Amendments to emergency relief and construction act and miscellaneous

Sec. 301. After the expiration of 10 days after the date upon which the Administrator has qualified and taken office, (1) no application shall be approved by the Reconstruction Finance Corporation under the provisions of subsection (a) of section 201 of the Emergency Relief and Construction Act of 1932, as amended, and (2) the Administrator shall have access to all applications, files, and records of the Reconstruction Finance Corporation relating to loans and contracts and the administration of funds under such subsection: *Provided,* That the Reconstruction Finance Corporation may issue funds to a borrower under such subsection (a) prior to Jan. 23, 1939, under the terms of any agreement or any commitment.

To bid upon or purchase bonds entered into with such borrower pursuant to an application approved prior to the date of termination, under this section, of the power of the Reconstruction Finance Corporation to approve applications.

Sec. 302. The amount of notes, debentures, bonds, or other such obligations which the Reconstruction Finance Corporation is authorized and empowered under section 9 of the Reconstruction Finance Corporation Act, as amended, to have outstanding at any one time is decreased by $400,000,000.

Sec. 304. If any provision of this act, or the application thereof to any person or circumstances, is held invalid, the remainder of the act, and the application of such provision to other persons or circumstances, shall not be affected thereby.

Sec. 305. This act may be cited as the "National Industrial Recovery Act."

Engineering
News-Record

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Preserve Momentum

THE PRESIDENT'S history-making approval of the Recovery Act last Friday was followed by orders and appointments hardly less significant than the act itself. These orders put the industry control section into full force and effect, while in the public-works field they cleared for immediate progress only a limited program—highways, naval vessels and federal buildings. Appointment of a "temporary" public-works administration, specifically limited to three weeks of existence, clearly indicates that state and city construction is to wait on further developments.

But no momentum need be lost because of this delay, regrettable though the delay appears. Work of definite value may be done in the time of waiting. There are preparations that remain to be completed for mobilizing needed and ready projects. There are technical and financial plans to be perfected. There are legal pitfalls and entanglements against which further preparation will be helpful. Legislation needs to be obtained, and above all more remains to be done in building up and keeping alive the public's active support of re-employment for recovery. These are vitally important ways of utilizing the three weeks' postponement.

It is essential, however, that there be no weakening of the spirit of cooperation which found expression in the passage of the act, in the preparatory work of assembling project lists and in the countrywide preliminary activities of the skeleton organization created at the President's own request. If the momentum generated by that spirit is maintained, if the preliminary organization is held ready in full effectiveness, and if the waiting time is utilized to perfect all plans, success is certain, and the time lost by the delay will be more than made up by greater speed of recovery.

The First Objective

INDUSTRIAL self-regulation now on the statute books places an immediate task of unprecedented magnitude upon industry: to put its house in order ready for the new call for service that will arise through the progress of recovery. As was stated clearly by General Hugh S. Johnson, the administrator of industry control, first action to this end is the drafting of fair practice codes, which in the main are the moral rules and statutes of marketing procedure. It is in the field of distribution rather than of production that industrial units are initially called upon to cooperate. Combining for joint action on production problems may be a later step and may call for different alignments, but this should not prove difficult when once the grouping by user markets has been achieved and suitable practice codes have been put into force. If the first objective is to make the business practices sound, cooperation of groups serving the same market appears to be the day's task.

Only a Preliminary

THE Emergency Railroad Act is but a preliminary to a more carefully worked out measure to improve rail-transport conditions, a temporary expedient from which some relief is to be expected while laying the foundation for more fundamental changes later. One provision of the act that will have an immediately beneficial effect on the railroads is retroactive repeal of the excess-earnings clause of the Transportation Act of 1920. In other respects, the new act's chief possibilities are its permissive features. It lets down the bars against cooperative action that might result in the elimination of some competition and permits the railroads to take a long step toward consolidation into regional groups and the elimination of duplicate facilities—with the only limitations that their action must be approved by the Railroad Coordinator as not detrimental to the public interest and that jobs must be found for men released through the consolidation of facilities. A year hence the nation will expect from the Coordinator a more definite program as a result of the experience gained under the present legislation.

Strength Well Maintained

AN encouraging example of results that can be accomplished through strength of purpose and leadership is presented by the American Water Works Association, whose Chicago convention last week gave proof of a spirit fully as active and progressive as at any time within the past half-dozen years, despite depression effects. Its papers and discussions were of high quality, keen interest was displayed in all the sessions, and there was ample evidence that a great deal of constructive technical work had been done during the year by members and committees. This is in the face of reduced personnel and the effects of almost complete stagnation of waterworks extension for two years past. In short, the association has been confronted by discouragements and retrenchment problems fully as great as those met in other fields. Perhaps its vigorous state is in part accounted for by the necessitous character of the service rendered by its art, and by the special responsibility that rests on the water engineer and operator. But the inspiration supplied by the leaders of the association's work is unquestionably a controlling factor. The enthusiasm, vision and energy that these men brought to the association's work during the past ten years or more are still the visible mainsprings of its action, and continue to carry it on to greater achievement.

Public Service of New Kind

WITH praiseworthy initiative, the Water Works Association last week decided to enter upon a new public service by undertaking an active compaign of promotion to aid immediate mobilization of public-works construction under the Recovery Act. Though the decision defies all technical-society tradition, it is obviously proper and commendable. The execution of the act represents so great a task as to claim every possible assistance from those able to give it, and most particularly the active assistance of men and organizations within the public-works field itself. These men, through their special knowledge of conditions and requirements, are in a position to render invaluable help in bringing together information on ready projects as well as on public needs that should have early place in the construction program. They have a corresponding responsibility, and this responsibility was recognized by the waterworks men even before the act went to final vote in Congress. They are entering on their promotion task in broadest spirit, moreover, aiming to bring out and give proper weight not only to water improvements but to other projects and needs that their campaign may discover. Their enterprise sets a model for all technical and semi-technical organizations.

Research Pays

RESEARCH plus depression prices are reflected in the revised estimates of the amount of money necessary to complete the sewage-treatment program of the Chicago Sanitary District. The new figures are $17,108,000 below former estimates, totaling $120,000,000 in place of about $138,000,000. Substitution of sludge incineration for digestion and drying eliminates not only the digestion tanks and sludge-drying beds but also the site required for a third plant (Southwest plant), as the incinerators are comparatively small and the present West plant site therefore is large enough to care for the additional facilities originally planned for the Southwest plant. That this is possible must be credited wholly to the intensive research conducted on laboratory and plant scale during the past three years. No better example could be found of how research pays in savings to the taxpayer. Further research may show that even larger savings are possible. In the light of the facts the district can make no better investment than maintaining its staff of engineering and scientific advisers intact.

Let There Be Light

ILLINOIS, through its governor, has just declared that it will proceed to seize cement at cement plants for its road construction by the power of eminent domain. Since February it has three times called for bids on cement and three times rejected the bids as too high, and it has also resorted to other and less open methods to beat down the market price. Governor Horner now says that he must have cement immediately to avoid wrecking this year's road program, but the proposed condemnation proceedings are likely to take a year or more in going through the courts, and the declaration therefore looks more like a threat than a means of cement procurement. Moreover, some nice legal questions surround the authority of the state to commandeer a manufactured product by the processes applicable to right-of-way lands and to gravel pits. It is hoped, however, that these questions will be waived, so that the condemnation suits may soon go to trial, for actual court proceedings will bring to decision certain novel and important questions. By applying to a product of industrial manufacture the methods of utility rate determination the court will lay down basic principles of fair price practice, involving not only operating and capital costs but also the variables arising from business fluctuation. Such principles were never as greatly needed as now, when fair adjustment of industry functioning is the great task of the day. In addition, the cement case is likely to bring out the bad effect of the practice of direct state buying.

A New Review of the Mississippi

NEW KNOWLEDGE and planning are being applied to flood control on the Mississippi River. A review of this development is given in this issue, and subsequent articles will explain its essential elements in greater detail. Operations on the river have been visited, records and reports have been searched, and the engineers in charge have been widely consulted to arrive at the facts. The information secured provides the first extended account of activities that modify all the theories and practices that have prevailed for years as Mississippi flood-control policy.

Under the new plans the great levee system of the river remains the accepted main bulwark against overflow, but it no longer ranks as the sole protection. Similarly bank revetment has been supplemented by channel regulation through an elaborate system of spur dikes; the purpose is to eliminate channel maintenance by dredging, which has been established policy for a generation. Exceeding all other changes, the tortuous course of the river, held inviolate for a hundred years from changes by man, is being straightened by artificially cutting off outstanding loops. Each of these changes flouts a respected river tradition. Together they combine to inaugurate a new era in the history of Mississippi River engineering.

All these changes of policy have long had advocates. They have come to fruition now because of engineering direction that does not fear to experiment and because means of experimentation have been provided by one of the greatest hydraulic laboratories of the world—the U. S. Waterways Experiment Station at Vicksburg, Miss.

Boldness of engineering initiative buttressed by experimental research has been the inspiration of the new planning. This spirit of research and of willingness to put its conclusions to actual trial deserved express recognition. It has prevailed in every rank of the engineering profession.

To the technical student of river improvement for navigation and flood control, the model-research laboratory of the Waterways Experiment Station is the particular creation of the new flood-control operations that has the greatest potential value to river hydraulic engineering. Its operations have therefore been given prominent attention in the present group of articles. With facilities for model experiments on scales greater than ever previously attempted, the laboratory is developing data of fundamental value on current action, detritus movement and sediment transportation that are building up a new scientific understanding of sediment charged streams. It is upon these data that much of the future work of channel deepening and slope rectification may be expected to be predicated.

Obviously the plan for making the Mississippi River in greater degree a self-contained stream has more than technical significance. It is a step toward the solution of the legal problem of the floodways. If, by transforming the river into a better hydraulic conduit, the floodway of the Boeuf-Tensas and the Atchafalaya basins can be measurably relieved of much of their potentiality for land damage, a critical problem of the original plan is simplified. This possibility is a fundamental element of the new planning. It magnifies it to a purposeful attempt to reach beyond flood-channel technique toward a solution of the greater problem of flood-protection engineering economics.

NEWS OF THE WEEK

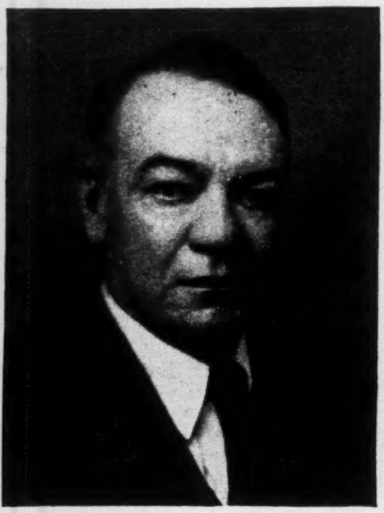
Public Works Under Recovery Act Subject to Delay

FOR reasons not made clear by the President's statement, inauguration of the full public works program under the National Industrial Recovery Act as passed last week has been held up until after the President returns from his vacation, about two weeks hence. Up to Friday, when the President signed the bill and issued an executive order confirming his unofficial appointment of Hugh S. Johnson as administrator of the Recovery Act, it was generally believed that Col. George R. Spalding, an army engineer who had been assisting General Johnson is outlining an organization to administer the act, would be appointed administrator of the public works section. However, when the President's order was issued Donald H. Sawyer, director of the Federal Employment Stabilization Board was appointed "to exercise temporarily the office of federal emergency administrator of public works." The President, in his statement concerning the Recovery Act said further: "During the coming three weeks, Title II, relating to public works and construction projects will be temporarily conducted by Col. Donald H. Sawyer as administrator and a special temporary board consisting of the Secretary of the Interior as chairman, the Secretary of Commerce, the Secretary of Agriculture, the Secretary of War, the Attorney General, the Secretary of Labor and the Director of the Budget.

"During the next two weeks the administrator and the board will make a study of all projects already submitted or to be submitted, and as previously stated certain allotments under the new law will be made immediately."

The President's executive order, in so far as it relates to the public works section, is as follows:

> Pursuant to the authority of "An Act to Encourage National Industrial Recovery, to Foster Fair Competition and to Provide for the Construction of Certain Useful Public Works and for Other Purposes," approved June 16, 1933, and in order to effectuate Title II—Public Works and Construction Projects—thereof:
>
> 1. I hereby appoint Colonel Donald H. Sawyer to exercise temporarily the office of Federal Emergency Administrator of Public Works.
>
> 2. I hereby appoint a special board for public works consisting of the following: The Secretary of the Interior, chairman; the Secretary of War, the Attorney General, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Labor, the Director of the Budget, Colonel George R. Spalding and Assistant Secretary of Treasury Robert.
>
> During the ensuing thirty days the Federal Emergency Administrator of Public Works shall have authority to allot the sum of not to exceed $400,000,000 provided for in Title II of said act for highway building for distribution among the States, territories and the District of Columbia, and authority to allot the sum of not to exceed $238,000,000 to the Department of the Navy for the construction of certain vessels, the construction whereof conforms to the London naval treaty and has heretofore been approved by me.
>
> The distribution of the money herein allocated for public roads shall be subject to the approval of the Board of Public Works.
>
> The Federal Emergency Administrator of Public Works is hereby authorized to employ such necessary personnel on a temporary basis as may be approved by the board.
>
> During the next twenty days it shall be the duty of the Federal Emergency Administrator of Public Works and the board herein constituted to study and report to me on all public works projects which have heretofore been submitted or shall hereafter be submitted.



Hugh S. Johnson

Donald H. Sawyer

NAMED TO ADMINISTER RECOVERY ACT

Board takes first action

Following the first meeting of the public-works board Secretary Ickes announced that he did not anticipate the release of any federal projects until the President's return, except possibly such as are held up in the Treasury Department. State and municipal projects, he said, would have to come up through an organization that has not been perfected.

The board adopted resolutions turning over $238,020,000 to the Navy for 32 vessels and $400,000,000 to the Bureau of Public Roads.

Aside from roads and vessels, the public works board will pass on all projects, according to Secretary Ickes, and then forward them to the President. District public works administrators will be appointed by the President. With each, will be associated an engineer and "an advisory group of private citizens of outstanding character."

The board appointed a subcommittee consisting of John Dickinson, Assistant Secretary of Commerce, and Rexford Tugwell, Assistant Secretary of Agriculture, to formulate general policy. Another subcommittee was appointed to consider interest rates to be charged on various kinds of projects and duration of loan periods. This subcommittee consists of Col. George R. Spalding, L. W. Robert, Assistant Secretary of the Treasury; James C. Biggs, Solicitor General; and R. O. Kloeber, assistant to the Director of the Budget.

Surety questions raised

Contractors are perplexed by the question of the surety that will be required of bidders on work financed under the Recovery Act. The administrator's office has not yet reached a decision and it is probable that the Treasury Department will be consulted. Establishment of a government insurance fund in lieu of bonding has been suggested in some quarters as the bonding companies are no longer willing and, in many cases, are unable to assume the risk unless the contractor deposits a large sum in escrow. It is understood that many contractors would prefer putting up their deposits with the government direct.

Strong sentiment still prevails in favor of writing predetermined rates of wages into contract specifications. This is not required by the law, except in road-building contracts, but is regarded as desirable by many contractors in order to eliminate the chiseler and the peddler. It is reported that Secretary Perkins is in favor of protecting wage rates by writing them into the contract and she may decide to urge adoption of this practice by the administrator. An amendment to the Bacon-Davis prevailing wage law to require predetermination was vetoed by President Hoover in July, 1932, because of the opposition of organized labor.

Contractors' code of practice

A code covering the operations and practices of general contractors has been drafted for consideration at the meeting of the Associated General Contractors of America in Chicago June 26 with the expectation that it will be submitted to General Johnson immediately thereafter.

Sawyer Named Temporary Head of Public Works Administration

Donald H. Sawyer who has been named temporarily to the position of federal administrator of public works by President Roosevelt, has been director of the Federal Employment Stabilization Board since its creation in 1931. In that position he had charge of the coordinating of the construction work of about 120 federal agencies in order to set up a continuous six-year cycle of operation. Previous to his work with that board he was with the Heating Board of Trade, New York, from 1930 to 1931, and was secretary of the Associated General Contractors of America from 1922 to 1929. Mr. Sawyer's early engineering experience was with the Illinois Traction System from 1905 to 1910 and with Sawyer Bros., of Seattle, from 1910 to 1917. During the World War he served as a colonel in the construction division of the army and after the war was with James Stewart & Co., New York, for two years.

The Federal Employment Stabilization Board is one of the federal boards abolished by a recent order of the President.

◆

American Engineers Named for International Study of Dams

A technical committee to represent the American Committee of the World Power Conference in the work of the International Commission on Large Dams has been named by the executive board of the American Committee. Elwood Mead, commissioner, U. S. Bureau of Reclamation, is to be chairman of the committee and the other members are as follows: Hugh L. Cooper, Albert S. Crane, and George A. Orrok, consulting engineers, New York; Glennon Gilboy, associate professor of soil mechanics, Massachusetts Institute of Technology; L. F. Harza, consulting engineer, Chicago; D. C. Henny, consulting engineer, Portland; F. R. McMillan, director of research, Portland Cement Association, Chicago; Brig. Gen. G. B. Pillsbury, Assistant Chief of Engineers, U. S. Army; James W. Rickey, chief hydraulic engineer, Aluminum Company of America, Pittsburgh; and R. F. Walter, chief engineer, Bureau of Reclamation, Denver, Colo.

The International Commission on Large Dams is meeting this year in connection with the sectional meeting of the World Power Conference being held at Stockholm and Oslo during the latter part of June. Following that meeting the recently appointed technical committee will take up such subjects as are referred to the representatives of the several countries for consideration.

◆

Conference on Slum Clearance To Be Held in Cleveland

A National Conference on Slum Clearance is to be held at the Cleveland Hotel, Cleveland, July 6 and 7. It has been called by the council of the city of Cleveland in order to bring out the latest information upon the subject of slum clearance and to formulate plans whereby slum clearance work can be fostered under the provisions of the National Industrial Recovery Act.

Contract Let for Pier Work

Contract for the construction of a pier for the Pennsylvania Railroad at Clinton St., Baltimore, to replace piers destroyed by fire about a year ago, has been let to the firm of Sinclair & Grigg, Philadelphia. The pier and superstructure is estimated to cost about $1,500,000.

◆

Sir Ernest Moir Dies; Authority on Subaqueous Tunnels

Sir Ernest William Moir, noted British authority on subaqueous tunnel construction and resident engineer for the contractor on the Pennsylvania R. R. tunnels under the East River at New York, died in London, England, on June 15, age 71 years. Mr. Moir's early work after graduation from college was with the staff of Sir William Arrol on the construction of the Forth Bridge. His first work in this country was as resident engineer for Sir Benjamin Baker when the latter, in 1888, undertook to complete the Hudson River tunnel using a shield and cast iron lining instead of tunneling and lining with brick. That work—carried on only from the New Jersey shore—was abandoned after about 2,000 ft. had been driven and Mr. Moir returned to England. Later he was placed in charge of the Blackwall tunnel construction for the firm of S. Pearson & Son.

Subsequently Mr. Moir returned to this country a engineer for S. Pearson & Son when that firm took the contract for the river section of the East River tunnels of the Pennsylvania R. R. For that work he designed the contractor's plant, the shield and tunnel lining having been designed by Alfred Noble and his staff as engineers of the East River tunnels for the railroad.

In later years Mr. Moir became a partner in the firm of S. Pearson & Son and carried out numerous port and tunnel operations including the Great Northern City Railway tunnel under London.

Boulder Dam Cement Contract Let for Modified Low-Heat Type

Contract has been let for 400,000 bbl. of special low-heat cement for Boulder dam, under modified specifications, at a price of $1.40 per bbl. f.o.b. mills, jointly to the California Portland Cement Co., Riverside Portland Cement Co., Monolith Portland Cement Co., and Southwestern Portland Cement Co. This price is reported to have been agreed upon following negotiations between the four cement companies and Secretary Ickes of the Department of Interior, after bids for cement had been twice rejected by Secretary Ickes as being too high.

In April the four companies submitted a joint bid of $1.55 per bbl. for 400,000 bbl. of special low-heat cement. This proposal was rejected, and bids were asked for on three specifications: (1) special low-heat cement; (2) modified specifications for low-heat cement; (3) standard portland cement. These same four companies again submitted a joint bid as follows: for No. 1, $1.55; for No. 2, $1.42; for No. 3, $1.30, all f.o.b. mills in bulk shipments. The $1.40 price under which the contract was let is a concession from the $1.42 bid of May 17 (*ENR* May 25, 1933, p. 697).

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Bids Postponed on Tunnel For Twin Lakes Water Project

The opening date for bids on the proposed tunnel and ditch of the Twin Lakes Reservoir and Canal Co., Ordway, Col., has been deferred temporarily. The new date will be announced later.

Postponement is believed to be due to funds being withheld by the R.F.C. following a protest from residents of the valley of the Roaring Fork, from which the canal company proposed to divert water, that it would be detrimental to them. Since the protest was made an agreement has been made to divert only flood waters.

WATERWAY OPENED FROM CHICAGO TO NEW ORLEANS

The accompanying photograph shows the first cargo of steel to move from Chicago to New Orleans over the Lakes-to-Gulf Deep Waterway. The shipment consists of 1,200 tons of steel sheet piling from the Chicago plant of the Inland Steel Co. This photograph was taken as it passed through Lockport, Ill. on its way to New Orleans from where it will be sent to Corpus Christi, Texas, for LaFruita dam.

On May 31 the Steamer Vicksburg left New Orleans en route to Chicago through the new waterways with a tow of barges with cargo from the lower valley and from South and Central America. This tow expects to reach Chicago on June 22.

Florida Surveyor Convicted of Practicing Without a License

G. M. Hopkins, of Broward County, Fla., on June 1, was convicted of practicing surveying without a license, as required within the state. On arraignment Mr. Hopkins pleaded nolo contendere, accepting a withheld sentence with a warning from the judge that if again arrested he would be sentenced on this old count regardless of a conviction on the new one. He promised to refrain from further practicing without a license.

The Florida law limiting the practice of engineering to persons qualified by the state board of engineering examiners was enacted several years ago but surveying was not included until in 1931. This is believed to be the first conviction under the law as it affects surveying.

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Board of Architectural Control Authorized for Vancouver

The town planning and building committee of the city council of Vancouver, B. C., has appointed a subcommittee to draft by-laws and define the duties of a board of architectural control for the city. The members of the board will be appointed to provide for rotation of the membership, two members to be architects, one an artist, one a structural engineer, one a lawyer, one a building contractor, and one a licensed real estate agent.

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Contracts Let and Bids Received For Colorado Aqueduct Tunnels

Contracts were let June 2 by the Metropolitan Water District of Southern California for six more tunnels of the Colorado River aqueduct aggregating 8.93 miles. Awards were as follows: West Eagle Mountain tunnel, east section, 2.97 miles, to Boderick & Gordon, Denver, $1,435,614; West Eagle Mountain tunnel, west section, 2.01 miles, to L. E. Dixon and Bent Bros., Los Angeles, $1,025,898; Hayfield No. 1 tunnel, 1.82 miles, to Hunkin-Conkey Const. Co., Cleveland, $814,952; Hayfield No. 2 tunnel, 1.02 miles, to J. N. Gordon & Floyd Shofner, Los Angeles, $471,889; Mecca Pass tunnels No. 1, 2 and 3, 1.11 miles, to Morrison-Knudsen Co., Boise, $575,685. The District furnishes all cement and steel, paying for haul from rail point; aggregates are secured locally, with payment allowed for haul of over two miles. All tunnels are horseshoe section 16 ft. in inside diameter. All bids on the East Eagle Mountain tunnel, 1.79 miles, were rejected and will be readvertised.

The following low bids were received on June 12 for four additional tunnels at the east end of the aqueduct: Colorado River tunnel, 1.07 miles, Copper Basin tunnel, 2.32 miles, and Whipple Mountain tunnel, 6.09 miles, combination low bid submitted by Walsh Const. Co., Davenport, Ia., $4,357,780; Whitewater tunnel, 1.9 miles, West Const. Co., Boston, $1,051,638. When these four tunnels are placed under contract, work will be in progress on the entire tunnel system of the aqueduct, aggregating 83.7 miles, excepting the East Eagle Mountain tunnel. The District is driving a total of 26 miles of tunnels in the Coachella Ranges by day labor.

Waterworks Men Organize to Foster Public Construction

IN ORDER to organize effectively its work of prompting waterworks betterment construction under the new Recovery Act, the American Water Works Association, at its annual convention at Chicago last week, set up a central committee which is to be assisted by five traveling coordinators. The coordinators are to make personal contact between the central committee and the local sections throughout the country.

The central committee comprises an advisory committee of several members and a steering committee of six members, under the chairmanship of Malcolm Pirnie, New York, president of the association. It will gather information relative to the operation of the public works act and forward it to the local sections. It also plans to cooperate closely with the American Society of Municipal Engineers, with associations of sanitary engineers and the chairmen of state public works committees.

The coordinators, acting under the direction of the central steering committee will call upon the chairmen of local-section steering committees, upon governors, health commissioners and local section heads. From such sources they will determine the communities where public works construction is needed and in which presentation of information to municipal officials will be helpful in getting public works authorized.

Local sections will also select steering committees who will select key men throughout their areas to use in presenting arguments in favor of initiating construction programs to municipal officials. The local steering committee will also present to governors, public works committees, state sanitary engineers and local federal administrators the information received from the central committee. This contact will be in the nature of offering the assistance of the A.W.W.A. in energizing local authorities to proceed rapidly with water works programs.

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Contract Let for Joint Terminal To Be Built in Muskegon, Mich.

Contracts have been awarded for the construction of the combined water, rail, air and bus port terminal of the West Michigan Dock and Market Corporation at Muskegon, Mich. The total project, estimated to cost about $1,000,000, is to be financed in part by a loan of $654,000 granted by the Reconstruction Finance Corporation.

Three major contracts awarded comprise: (1) Construction of the buildings, paving roadways and laying railway tracks; awarded to Bryant and Detwiler Co., Detroit, Mich.; (2) Dock construction and piling; Edward E. Gillen, Milwaukee, Wis.; and (3) Sand fill and grading; Sand Products Corporation, Detroit, Mich.

Building construction contracts exclusive of equipment amount to approximately $350,000 and the marine or dock and piling contract to $75,000.

Plans for the entire development were prepared by Stahl and Adams, architects and engineers, Detroit, Mich.

Explosion in Pipe Under Repair Fatal to Two Men on the Work

An unexplained accident that occurred at Cincinnati while repairing a steel pipe on June 9, was reported at the meeting of the A.W.W.A. The line, 48 in. in diameter, had developed a leak and a steel section about 12 in long was being electrically welded to the inside of the pipe at the leaking point. The topography at that point is such that the line rises in elevation nearly 100 ft. in a distance of about 300 ft. Manholes were provided at both the bottom of the hill, near where the repair was under way, and at the top. The pipe was coated inside and out. Coated electrodes were being used. Suddenly an explosion occurred. A heavy 48 in. valve at the high end of the line was cracked open completely around the bonnet. Two men were killed. In an attempted rescue, an inspector crawled into the pipe several hundred feet, when he became unable to move, as if paralyzed, although his mind remained completely clear. He was rescued and recovered. A fire marshal, who removed the body of one of the workmen, reported the next day that the cotton shirt he had been wearing had fallen apart. A mine safety lamp lowered into the pipe gave evidence of abundant oxygen and no explosive gas mixture. No completely satisfactory explanation of the explosion has yet been made.

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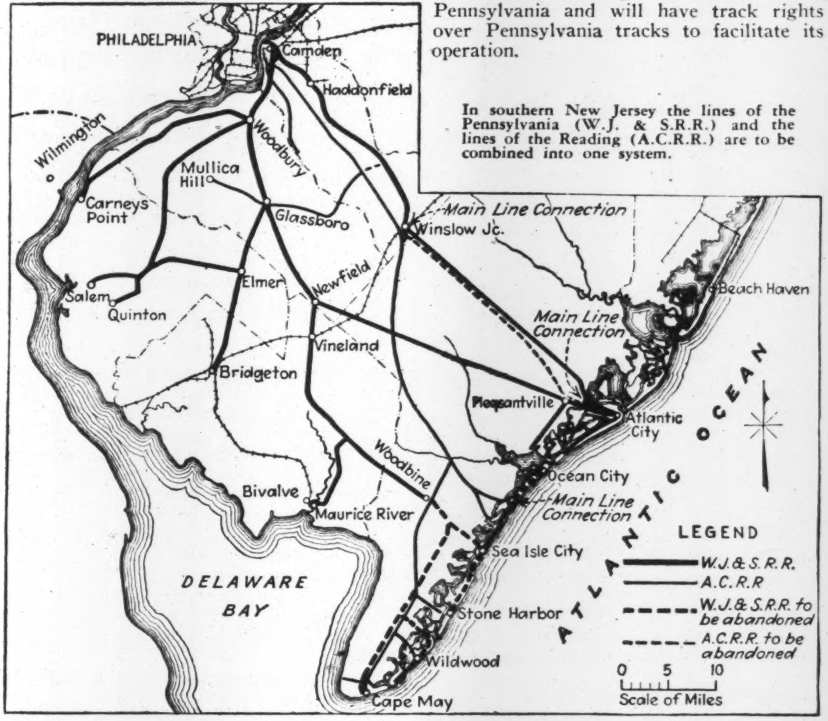
Chicago Sanitary District Revises Construction Program

Expenditures required to complete the program of sewage treatment projects of the Sanitary District of Chicago are estimated at $120,367,500 in a new report prepared by the district's engineers. This new estimate, $18,208,000 less than that in the last semi-annual report to the Supreme Court, is made possible by the elimination of the sludge digestion and substitution therefor of incineration. Development of new processes is accountable for $17,108,000. Application was made to R.F.C. some time ago for funds with which to proceed as the tax situation in Cook County then precluded the sale of bonds through ordinary channels. A new application to the Federal Emergency Administration under the Recovery Act requests $120,000,000 with which the project can be completed. This will permit carrying out the mandate of the Supreme Court to reduce the diversion to 1,500 sec.-ft. by 1938. The year-to-year expenditures start with $17,080,500 for 1933, rise the next year to $23,212,300 and then are gradually reduced to $16,400,000 in 1938. The estimate of the total necessary further expenditures, made when the decree was entered in 1930, was $179,744,000 on which program $10,691,000 has been spent.

The Illinois State Legislature has recently passed a bill permitting the district to issue $100,00,000 bonds without referendum. These bonds together with $40,000,000 bonds on the district's shelves (unsold because of the local tax situation wherein some bonds and overdue interest are in default) are the collateral on which the district hopes to obtain a federal loan permitting work to proceed at once. Lack of funds early last year stopped construction on $8,793,000 work under contract. This work can be resumed immediately.

Pennsylvania and Reading Lines Combined in South Jersey

Joint use of the railroad facilities of subsidiaries of the Pennsylvania R.R. and of the Reading Company serving towns in south Jersey and the shore points from Atlantic City to Cape May, as proposed in an agreement reached between the two railroads on Nov. 23, 1932, was approved by the Interstate Commerce Commission on June 10, as noted briefly in the issue of June 15. The services of the two railroads closely parallel each other at many points especially between Camden and Atlantic City and both have been under pressure by officials of Atlantic City to eliminate grade crossings there and modernize their terminal facilities.



In southern New Jersey the lines of the Pennsylvania (W.J. & S.R.R.) and the lines of the Reading (A.C.R.R.) are to be combined into one system.

The Pennsylvania Railroad leases the West Jersey & Shore Line and the Reading Company owns the majority of the stock of the Atlantic City Railroad Co. The lines of these two railroads in south Jersey are shown in the accompanying map. As indicated on the map, the Atlantic City R.R. from Winslow Junction to Atlantic City is to be abandoned and the West Jersey & Seashore R.R. will abandon its line from Mt. Pleasant Junction to Cape May and other lesser lines reaching shore points. In Atlantic City it is proposed to build a new passenger station to replace the two existing passenger stations. However, this is not specifically covered in the agreement.

To make joint operation effective, the Reading Company will deliver to the Pennsylvania R.R. for a nominal sum two-thirds of the common and two-thirds of the preferred stock of the Atlantic City Railroad Co. and the Pennsylvania R.R. will assign to the Atlantic City Railroad Co. its lease of the West Jersey & Seashore R.R. After this has been done the name of the Atlantic City R.R. Co. will be changed to "Pennsylvania-Reading Seashore Line" and this company will now operate the railroad lines now operated by the two companies independently. Thereafter the relation of two-thirds ownership by the Pennsylvania and one-third by the Reading will be continued and funds required for new construction will be provided on that basis by the parent companies.

At Camden the Atlantic City Railroad Co. will abandon the use of its ferry terminal and will turn it over to the Reading Railroad Co. and will operate from the Camden terminal of the Pennslyvania R.R. It will also use engine terminals of the Pennsylvania and will have track rights over Pennsylvania tracks to facilitate its operation.

Bond Issue for Filtration Plant Approved for Gretna, La.

A bond issue of $210,000 for the construction of a water filtration plant and for enlargement of the present waterworks system of Gretna, La., across the river from New Orleans, was ratified at the general election held June 13.

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Construction of Shallow Canal Urged for West Coast Project

The canal commission created by the 1933 legislature of the State of Washington has recommended to Governor Martin early construction of the proposed Puget Sound-Grays Harbor-Willapa Harbor-Columbia River ship canal as a shallow draft canal. The commission believes that construction of the three units of the proposed canal to a depth sufficient for sea-going ships drawing 13 ft. in salt water can be economically justified. The total cost will be about $34,000,000. The commission recommends the construction of a lock canal between Puget Sound and Grays Harbor with locks not less than 60 ft. wide and 600 ft. long.

State of Washington Bond Issue Approved by Supreme Court

The Supreme Court of the State of Washington has passed favorably upon the bond issue of $10,000,000 recently authorized by the state legislature for relief work.

Among the projects being considered for financing with the proceeds of this issue are clearing up Seattle's Cedar River watershed, flood control on the Snoqualmie River, completion of the Lake Washington sewer system and water department improvements.

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Alternate Bids to Be Required On Highway Work in California

Alternate bids will be required on standard highway designs for "asphalt concrete pavement and portland-cement concrete pavement" on high-type highway construction in California where "conditions do not require the use of a particular type of pavement" in accordance with the law recently signed by the governor and effective Aug. 22. The legislation was openly backed by the petroleum industry of the state. No regulations have been provided as yet to govern the administration of the act.

The measure is contained in a single paragraph and its full text follows:

"Whenever any high-type paving work is to be done by contract under the control and direction of the Department of Public Works which is to be paid for in whole or in part with moneys coming out of the state highway maintenance fund or the state highway construction fund, and in the judgment of said department the conditions do not require the use of a particular type of pavement, the said department shall cause to be prepared alternate plans and specifications contemplating the use of all such materials as are adopted as standard for high-type paving by the division of highways and acceptable to it. The Department of Public Works shall then advertise and call for bids for the doing of such work based on the use of such alternate materials and upon receipt of such bids shall proceed to the award of a contract to the lowest qualified bidder. Whenever the words 'high-type paving' are used in this act, they shall be construed to include only asphalt concrete pavement and portland cement concrete pavement as designed by the division of highways."

The act does not provide for any change in the present design practice of the division of highways and it does not affect those construction projects definitely suited to a particular type of work. This includes such work as (1) resurfacing of old pavement with a top coat of asphaltic material, (2) the use of cement concrete on mountain grades or (3) secondary road construction.

For those projects, however, where present standard specifications for either type of high-grade surfacing might be specified the bill provides that the relative cost of the two types of construction shall govern. According to present California design for this type of highways, the quantity of surfacing material of either type for a unit length of highway is about the same. One ton of asphaltic concrete is estimated to cover 2.47 sq. yd. and 1 cu. yd. of cement concrete provides for an average of 4.8 sq. yd. of surfacing.

Waterworks Activity Reported at the A.W.W.A. Convention

Among the several hundred members who attended the annual convention of the A.W.W.A. in Chicago last week were many who have been engaged in waterworks construction activities during the past year. The field has by no means been stagnating according to reports in *Waterworks News-Record,* the daily of the convention which is published each year by *Engineering News-Record.* As a matter of record and to give a general picture of recent waterworks activity some of these reports are republished here.

Chicago has been working on its Chicago Ave. intake tunnel and is planning a new offshore crib adjacent to the present Harrison Ave. crib. Wilmette, Ill., has a new 6-m.g.d. plant under way and at present is laying the 33-in. intake pipe into Lake Michigan. Springfield is actively pushing earth dam construction for a 4,300-acre lake to be used for water supply and recreation purposes. The main dam is 35 ft. high. Each dam is 1,800 ft. long and the total earth moving involved is 450,000 cu. yd. Dixon, Ill. is building a new 125,000 gal. elevated tank.

In Indiana, Bloomington has received R.F.C. approval for a $428,000 plant and Richmond has plans ready for a $375,000 plant and is seeking financing.

Mid-west projects

One of the most interesting projects in the Middle West is about to start at Herington, Kan. It involves the use of sewage effluent as water supply for the Rock Island Railroad. According to Black & Veatch, consulting engineers, Kansas City, who have designed the plant, it will provide 500,000 gal. per day at a considerable saving to the railroad which now takes water from a creek, badly burdened with sewage, and attempts to treat it for boiler purposes. The plant is of the activated sludge type. Its cost is about $60,000. The R.F.C. is providing the funds. Also in the Middle West, Hobart, Okla. (5,000 pop.) has a new supply underway consisting of a 1,500 ft. earth dam, concrete spillway and 8½ miles of 14-in. cast iron pipe. It is the first R.F.C. project in the state. In Texas the Tarrant County Water Control and Improvement District 1 is beginning work with $450,000 of R.F.C. money to remove the Rock Island Railroad tracks from its Bridgeport Lake basin in Wise County.

Milwaukee put a 6-m.g. steel storage tank in service during the year, has let contracts for 1¼ miles of 36-in. cast iron pipe and is considering a 200 m.g.d. purification plant on the lake shore. Cleveland has let a contract for the excavation for a high service reservoir to serve the southwest part of the city. St. Louis laid 10,000 ft. of 36-in. cast iron pipe during the year, Conneaut, Ohio, has received bids for a 3 m.g.d. filter plant, a 24-in. intake and a 500,000 gal. elevated tank; the R.F.C. providing $275,000.

Colorado Springs built a 4 m.g.d. emergency filter because of a serious shortage (ended by heavy snowfall in May) and is planning a new 16 m.g.d. plant so that all of the city's supply can be filtered.

On the Pacific Coast Los Angeles is spending $2,000,000 in enlarging its distribution system, $4,000,000 to complete the Boquet Canyon Dam, has put in a fill below Mulholland Dam, has started a new dam in Long Valley and has begun work on the Mono Basin project. In addition there is the huge amount of work on the Colorado River Aqueduct. San Francisco will have the Hetch Hetchy system in operation in 1934. The most important construction work underway is the driving of the 28½-mile 10½-ft. Coast Range tunnel. Pasadena is busy on the San Gabriel project including Pine Canyon Dam.

Work in the South

In the South new water plants have been built at Lebanon, Tenn., and at Manchester and Gainsville, Ga. Greenwood, S. C., reconstructed its reservoir and Macon, Ga., has varied improvements underway. In Baltimore the Pretty Boy Dam is nearing completion. Chambersburg, Pa., has a 60-ft. dam to impound 350 m.g. underway and Lancaster's 16 m.g.d. filter plant is nearly complete.

Toronto has made great progress on its $14,500,000 duplicate waterworks system. Remaining work comprises the 200 m.g.d. filter plant and a 1½ mile intake, into Lake Ontario; the first mile of this intake is in rock 100 ft. below lake bottom. Boston reported work at four separate shafts on the 12 ft. tunnel between Wachusett and Quabbin reservoirs and completion of the 30 ft. diversion tunnel which will carry the Swift River during construction of Quabbin Dike. Hartford is taking bids for a new supply which ultimately will include a 140 ft. earth dam to impound 27 billion gal. New York City has its $43,000,000 tunnel from the Bronx to Brooklyn 95 per cent complete. A contract was recently let for a 5 m.g.d. iron removal plant at Flushing.

Manufacturers' exhibits

The exhibits of equipment and materials at the convention were in every respect the equal of any former year. Each year more equipment in actual operation is shown. Ingenuity and salesmanship are being used in planning exhibits, the same as they have used in business. New products were shown, indicating that design activity has gone ahead during the depression. In brief, advances in knowledge of water handling and treatment are being followed closely by improvements in the necessary equipment.

Building Mechanics in Chicago Begin to Go Back to Work

Estimates made by building trade unions and contractors in Chicago indicate that 30,000 mechanics have been called back to work. Rehabilitation and modernization programs have resulted in the taking of many of these men back on the payroll again after three years' idleness. Vacant rentable space is only 7 per cent above normal, according to the Commonwealth Edison Company. Some 7,000 of the 14,000 painters are at work on modernization at a reduced wage scale of $1.00 against the normal $1.41 for new work. The electrical workers union has cut its scale by 35 per cent to $1.06¼ per hour. These wage reductions are for rehabilitation work only.

Illinois to Obtain Cement by Condemnation Proceedings

In order to obtain about 3,300,000 barrels of cement for highway work at what Governor Horner of Illinois considers "fair and equitable prices," the Attorney General of the state has been ordered to file condemnation proceedings against cement held in stock by four cement companies having mills within the state, leaving it to the court to determine what price shall be paid. All bids on the cement for highway work have been rejected repeatedly by the governor as being too high.

Indianapolis to Enlarge Plant For Activated Sludge Treatment

Following the appointment of Charles H. Hurd as consulting engineer to the Indianapolis Board of Sanitary Commissioners orders were given on June 15 to prepare at once plans and specifications to complete the activated sludge treatment plant and to increase its capacity. The cost is estimated at $600,000.

New York Sewage Works Men Hold Meeting at Rochester

The New York State Sewage Works Association held its spring meeting at Rochester, N. Y., June 9 and 10, with 130 members and guests registered.

The convention opened with a brief business meeting and the presentation of two technical papers, one by Frank C. Roe, engineer, The Carborundum Co., Niagara Falls, on some things that have been learned about sewage aeration by diffused air, was discussed by A. B. Holmstrom of the Norton Co., Worcester, Mass.; and the other by William Gavin Taylor, consulting engineer, Newark, N. J., on vacuum filtration in sewage treatment.

The afternoon session opened with a paper by L. A. Bergman, Director of Public Works of Jamestown, on "Sewage Treatment at Jamestown, N. Y." with a discussion by H. Burdette Cleveland. This was followed by a symposium on the operation of small sewerage systems and treatment plants, led by William A. Ryan, consulting chemist of Rochester. The session closed with a paper by John Lewis, director, bureau of maintenance and operation, Department of Public Works, Rochester, on the selection and maintenance of mechanical sewage equipment. Throughout the meeting a lively discussion followed each paper.

On Saturday a lively question box and round table discussion was conducted by Morris Cohn of Schenectady. This feature has found a very definite place in the program and is proving most valuable to the operators. The Saturday morning session closed with two papers describing the plants to be visited, one by Glenn D. Holmes, consulting engineer of Syracuse, on features of the revamped plant at Newark, and the other by R. G. McDonald, engineer of the village of East Rochester, on operating experiences at the East Rochester plant, each of which was briefly discussed.

The next meeting of the association will be held in White Plains in October at a date to be fixed later.

New Jersey Highway Engineer Suspended Under Charges

Jacob L. Bauer, engineer of the New Jersey state highway commission, has been suspended by the newly organized highway commission upon charges of misconduct in office after having refused to resign.

The highway department of New Jersey has been the center of political wrangling for some time past and the present move to supplant Mr. Bauer is not unexpected. Mr. Bauer has been state highway engineer since 1929. In 1931 he was reappointed for a 4-year term.

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Contractor Not a Federal Agent on Levee Construction Work

A special three-judge tribunal in the federal court at New Orleans recently dissolved an interlocutory decree obtained by the Trinity Farms Construction Co. to restrain the supervisor of public accounts of the state of Louisiana from collecting the state 5 per cent per gallon tax on gasoline and motor fuel supplied to the company for work on the construction of levees for the United States government in the Atchafalaya River valley. The company resisted the collection of the gasoline sales tax on three points, (1) that it is not a dealer, (2) that the gasoline is not used or consumed on state highways or public roads but entirely on right-of-way turned over to the federal government, and (3) that the company is an agency or instrumentality of the United States government. The court threw out all claims, stating that the tax was on the use of products and that the plaintiff's relation to the government is only contractual.

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SOCIETY CALENDAR

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Chicago, Edgwater Beach Hotel, June 26-30.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS, Annual meeting, Purdue University, Lafayette, Ind., June 21-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, Palmer House, June 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Chicago, Palmer House, June 27-July 1.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, Milwaukee, Wis., Sept. 25-27.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, Stevens Hotel, June 26-30.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual convention, Chicago, Stevens Hotel, June 26-28, 1933.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, Stevens Hotel, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 26-July 1.

THE JOINT COUNCIL OF ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS has elected Joseph E. Vollmar, vice-president of the Fruin-Colnon Contracting Co., its president. John Hunter, consulting engineer, was elected vice-president, and C. Kraft was elected secretary-treasurer.

THE ROCHESTER ENGINEERING SOCIETY has elected John W. Morrision, chief engineer of the Rochester Telephone Co., president; Hay H. Manson and George C. Van Vechten, vice-presidents; Maynard C. Lee, secretary, and Howard Harding, treasurer.

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Personal Notes

John J. Felsecker, a specialist in water softening, has been added to the staff of D. W. Haering & Co., water consultants, Chicago.

Z. E. Sevison, until recently chief engineer of the Wyoming state highway department, has been retained as consulting engineer to the department.

Tazwell Ellett, former office engineer of the state highway department of Virginia, has been elected to the newly-created position of county engineer of Henrico County, Virginia.

John E. Elliott has been appointed division engineer of the American Bridge Co. to succeed the late P. J. Reich. Ferrand S. Merrill has been appointed assistant division engineer to succeed Mr. Elliott.

A. U. Shipman, recently appointed city engineer of Duluth, Minn., has resigned because of the pressure of personal business. He has been succeeded by T. F. McGilvray, former city engineer.

Harry E. Frost, Findlay, Ohio, has been appointed superintendent of maintenance of Hancock County, Ohio, for the state highway department, to succeed Charles L. Briggs, deceased.

W. W. James, valuation engineer of the Central Railroad of New Jersey, has been named real estate and tax agent for the railroad in addition to his work as valuation engineer.

John L. Van Ornum, professor of civil engineering at Washington University, St. Louis, Mo., has been given a leave of absence of a year and will retire from active teaching work at the expiration of the leave in order to devote his time to writing.

Roy A. Klein has established an office as a consulting engineer in the Failing Building, Portland, Ore. During the past nine years Mr. Klein has been state highway engineer of Oregon and previous to that time was in railroad and highway engineering work.

H. V. R. Thorne, for the past seven years located in Mexico City in charge of construction for the J. G. White Engineering Corp. on irrigation work for the Mexican Government is now located at Chalma, New Mexico, in charge of construction of the El Vado dam for the Middle Rio Grande Conservancy District.

Edmund R. Kinsey, former president of the Board of Public Service of St. Louis, has opened an office as a consulting engineer in the Railway Exchange Building, St. Louis. Mr. Kinsey was in private practice there from 1899 to 1905, specializing in municipal work and since 1905 has been in the city service.

J. R. West, former engineer of the Port of Seattle, has been named general manager of the port, a new position recently created. Mr. West was removed from the position of chief engineer on March 15, but has been reinstated by the new commissioner and in his new position will have the title of general manager and chief engineer.

Richard H. Merriman has been appointed superintendent of the Cochella division of the Colorado River aqueduct work of the Metropolitan Water District of Southern California to succeed J. L. Burkholder, recently appointed assistant general manager of the water district. Lester V. Branch has been appointed assistant to Julian Hinds, assistant chief engineer of the district.

D. C. Henny, consulting hydraulic engineer, Portland, Ore., has been elected an honorary member of the Royal Institute of Engineers of the Netherlands. Mr. Henny has been a full member of the Institute most of the time since his graduation from the Polytechnic Institute of Delft over 50 years ago. On June 5 Mr. Henny also was honored with the degree of doctor of engineering by Oregon State College.

Fred J. Lewis, acting dean of the school of engineering, Vanderbilt University, since the death of Dean Schuerman, was appointed dean of the school on June 12. Dean Lewis came to Nashville ten years ago as associate professor in the school of engineering. He took his engineering degrees at Lehigh University and Pennsylvania State College and taught at both institutions before going to Vanderbilt University.

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Obituary

Herbert R. Wood, engineer for the New York Central Railroad at Utica, N. Y., died there on June 5 from injuries received in an automobile accident on June 1.

Charles L. Biggs, superintendent of maintenance of state highways in Hancock County, Ohio, died at his home in Findlay, Ohio, of a heart attack on June 9, age 55 years.

Edwin J. Jolley, for the past 20 years engineer in charge of grades and surveys for the Board of Public Service in St. Louis, Mo., died there on June 10, age 77 years, following a brief illness. Mr. Jolley entered the city's service 43 years ago.

Frederick Wilcock, an engineer of the Board of Transportation, New York, died at his home in Brooklyn on June 15 after several months' illness, age 59 years. Mr. Wilcock was a native of England and graduated from the Engineering School at Harvard in 1900. Shortly after graduation he entered the employ of the Public Service Commission at New York and had been engaged in engineering work in that city since that time.

William H. Warnock, town engineer of Montclair, N. J., died suddenly of a heart attack at Bayhead, N. J., on June 17, age 50 years. Mr. Warnock was a native of Northampton, Mass., a graduate of the Massachusetts Institute of Technology in the class of 1905. Soon after graduation he joined the engineering staff of the Board of Water Supply of New York City, subsequently becoming a section engineer in charge of a part of the Catskill Aqueduct. During the World War Mr. Warnock served as a captain in the Construction Division and after the war held various positions in New York before becoming town engineer of Montclair in 1923.

Brief News

The U. S. Engineer Office at Oswego, N. Y., is to be closed on July 1 after having been in existence since 1823.

Lining Part of the Moffat Tunnel with concrete is being undertaken by the Denver & Salt Lake Railroad Co. with its own forces.

Pressure Tests recently conducted on the new water tunnel under First Narrows at Vancouver showed a leakage of less than a gallon per minute, and the tunnel has been put into regular operation.

Organization of a Metropolitan Water District in the Wenatchee Valley in the State of Washington has been begun in order to secure a new water supply from Icicle Creek for a number of communities in the valley. R. H. Thomson, former city engineer of Seattle, has prepared plans for the work, estimated to cost about $800,000.

Work on the Hope-Princeton Section of the southern trans-provincial highway in British Columbia has been resumed with the federal government in charge of the work. Construction of the highway was begun by the provincial government with relief hand labor but was not completed for lack of sufficient funds.

Diversion of $2,000,000 of the $10,000,000 state relief bond issue to finance flood control work along the White and Puyallup rivers in Washington has been urged upon state officials by the Inter-County River Improvement Board representing Peirce and King Counties. B. P. Thomas, Tacoma, is engineer for the board.

In Order to Close a Drawbridge at Oshkosh, Wis., opened during the recent hot spell to permit the passage of a boat, the bridge tender had to call on the fire department to spray water on the bridge in order to contract the steel work sufficiently to let it return to its closed position.

Contract for the Copper Cables for the transmission line from Los Angeles to Boulder Dam, amounting to $2,399,800 was awarded on June 7 by the board of water and power commissioners of Los Angeles to the General Cable Corp. The line will be 251 miles long, carrying two circuits of three conductors each. The cables will be 1¼ in. in diameter. Delivery of the first cable is to begin on Jan. 1, 1934 and completion is called for a year later. Total cost of the line with its switching and substations is estimated at $22,800,000.

Three Bids for Completion of the Diablo unit of the Skagit River hydroelectric power project in the city of Seattle were received recently by the city in response to its call. The amounts have not been made public and it is stated that none of the bids was in complete compliance with the specifications. The bids are being held for study and recommendation.

Bids for Dredging about 3,000,000 cu.yd. of material from the deep water channel between Aransas Pass and the port of Corpus Christi were opened recently by the district engineer. A low bid of 4.23 cents per cu.yd., a total of $128,015, was received from the Standard Dredging Co., New York. Other bids were 4.97 cents from the Sternberg Dredging Co., St. Louis, and 5.43 cents from the Atlantic, Gulf & Pacific Co., New York. The government estimated that the work could be done with its own plant for 4.66 cents per cu.yd. The channel is to be dredged to a depth of 34 ft. over a distance of 20½ miles.

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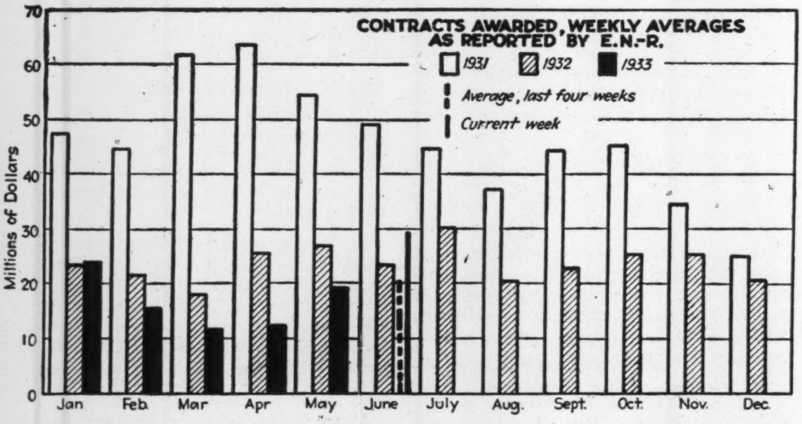
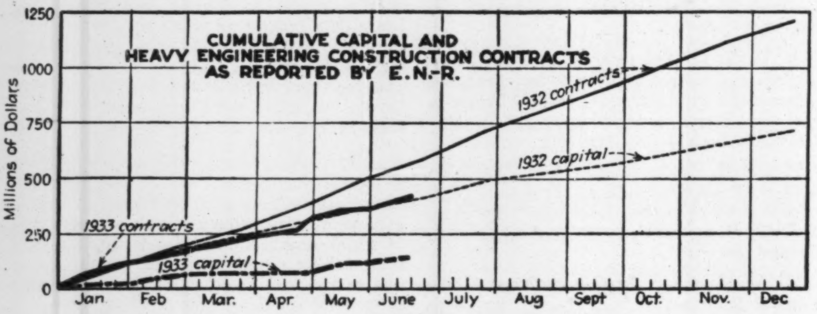
Engineering Contracts and Capital

Award of four large contracts amounting to over $18,000,000 raised the total of heavy engineering construction contracts reported last week to $29,329,000, a weekly total surpassed only twice this year. The four large single awards are: Oil refinery, Texas City, Tex., $8,000,000; tunnels on the Colorado River aqueduct, $5,409,000; Jackson County courthouse, Kansas City, $2,500,000 and cables for the transmission line, Los Angeles to Boulder Dam, $2,399,000. Public works lettings amounted to $17,087,000, as compared with $5,511,000 the previous week, even though federal awards were at a low total of $578,000. Private contracts totaled $12,242,000, the second highest weekly figure of the year for this class of work. Contracts let the past four weeks have averaged $20,304,000. In June of last year awards averaged $23,717,000 per week. Cumulative contracts let to date this year total **$422,726,000,** about 74 per cent of the 1932 volume.

New productive capital issues sold last week, all public, amounted to $14,694,000, one of the highest weekly totals of the year. Included in this total is a $5,000,000 highway bond issue sold by Missouri. The R.F.C. announced additional self-liquidating loans aggregating $175,500, bringing the total of approved loans of this character to $205,038,000.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly June 1932	Average Four Weeks	Week June 22, 1933
Federal government	$6,384	$508	$578
State and municipal	12,002	9,350	16,509
Total public	$18,386	$9,858	$17,087
Total private	5,331	10,466	12,242
Week's total	**$23,717**	**$20,304**	**$29,329**
Cumulative to date:			
1932		$574,379	
1933		422,726	

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly June 1932	Average Four Weeks	Week June 17, 1933
New capital issues	**$12,600**	**$9,680**	**$14,694**
Cumulative to date:			
1932		$394,800	
1933		151,081	

R.F.C. self-liquidating loans:	
Approved current week	$176
Approved to date (including 1932)	205,038
Actual loans made (including 1932)	47,195

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ENR Cost and Volume Index

E.N.-R. Cost		**E.N.-R. Volume**	
June, 1933	**163.41**	**May, 1933**	**103**
May, 1933	164.39	April, 1933	65
June, 1932	152.20	May, 1932	149
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260

1913 Average........ 100